ENGINEERING AND

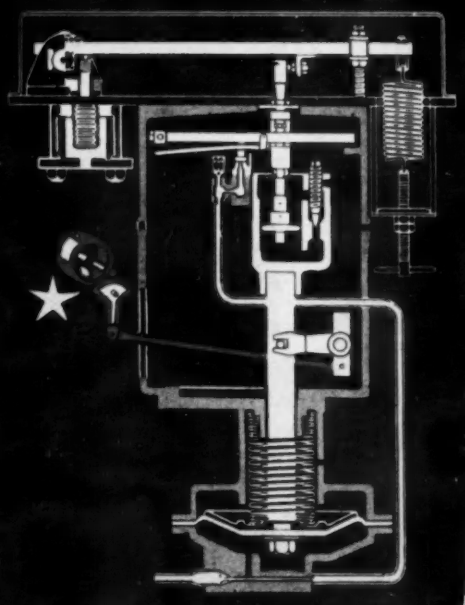
BOILER HOUSE REVIEW

VOL. 73 NO. 10 • THE PIONEER STEAM JOURNAL • OCTOBER, 1958

ELECTROFLO-SMOOT

Electronic

BOILER CONTROL



Steam generation is a mechanical process. Its successful automatic control requires not only the precise, immediate detection of departures from norms, but *power—precisely applied*—at the final regulating means.

Electroflo - Smoot Control employs pneumatics, hydraulics and electronics solely or in combination—with good sense and unrivalled experience—to suit the specified plant and its operating conditions.

The advanced type electronic system not only eliminates distance transmission lags in high capacity, high energy level steam generators, but—through "steam load" control—it provides the shortest path from the electrical load change to the combustion rate. **Ask for Publication No. S.848.**

★ Electric signal sender to receiving regulator or power unit. System includes integral feedback and bumpless transfer from automatic to manual (constant rating) control.

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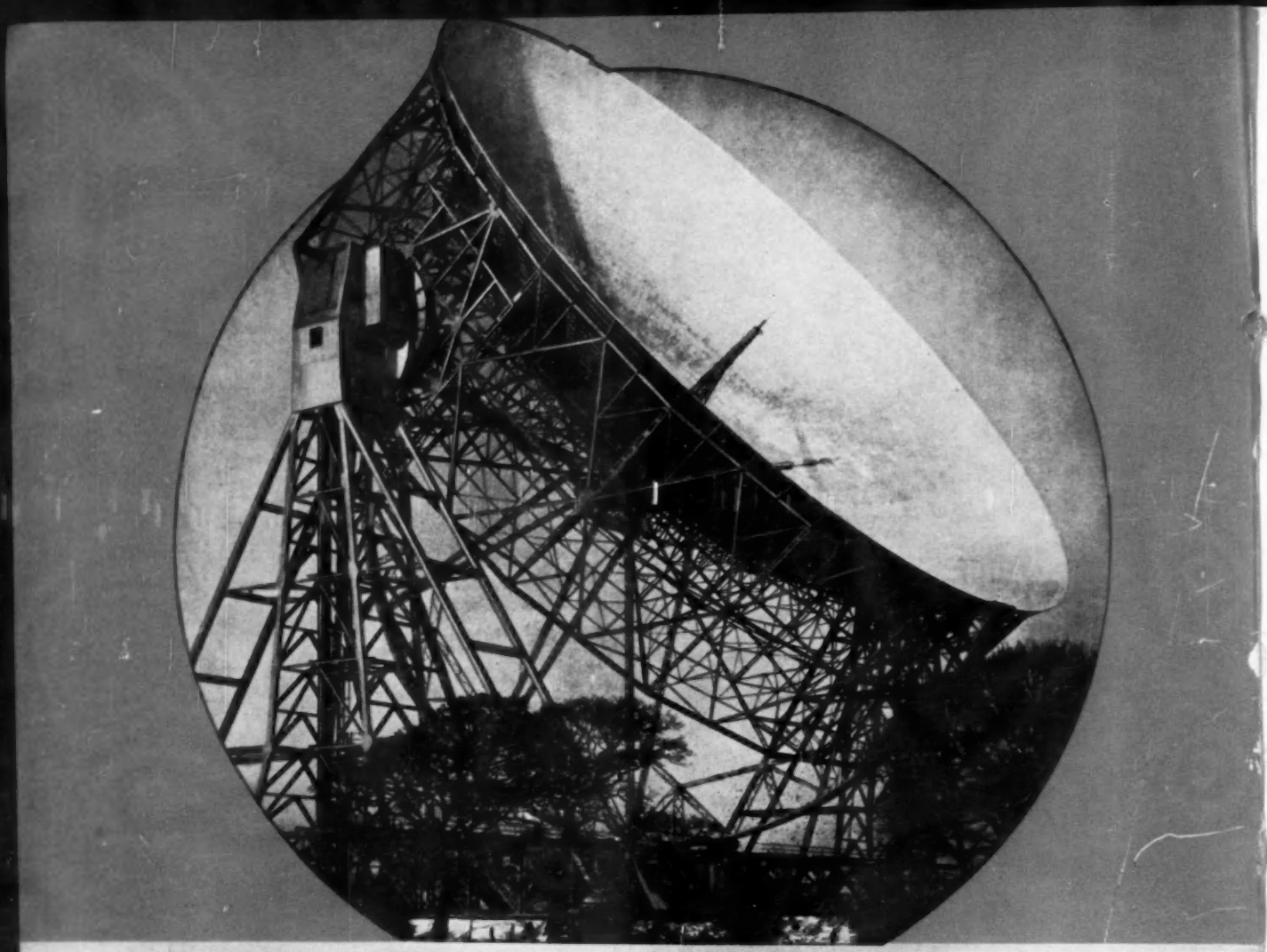

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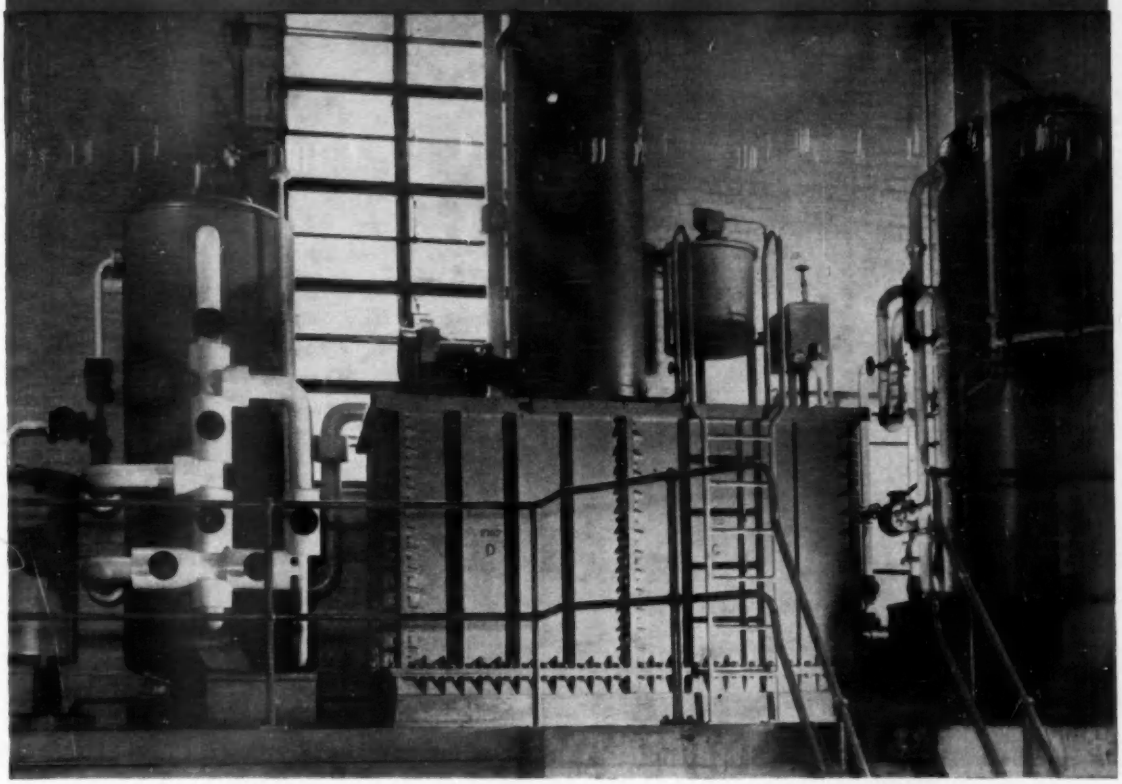

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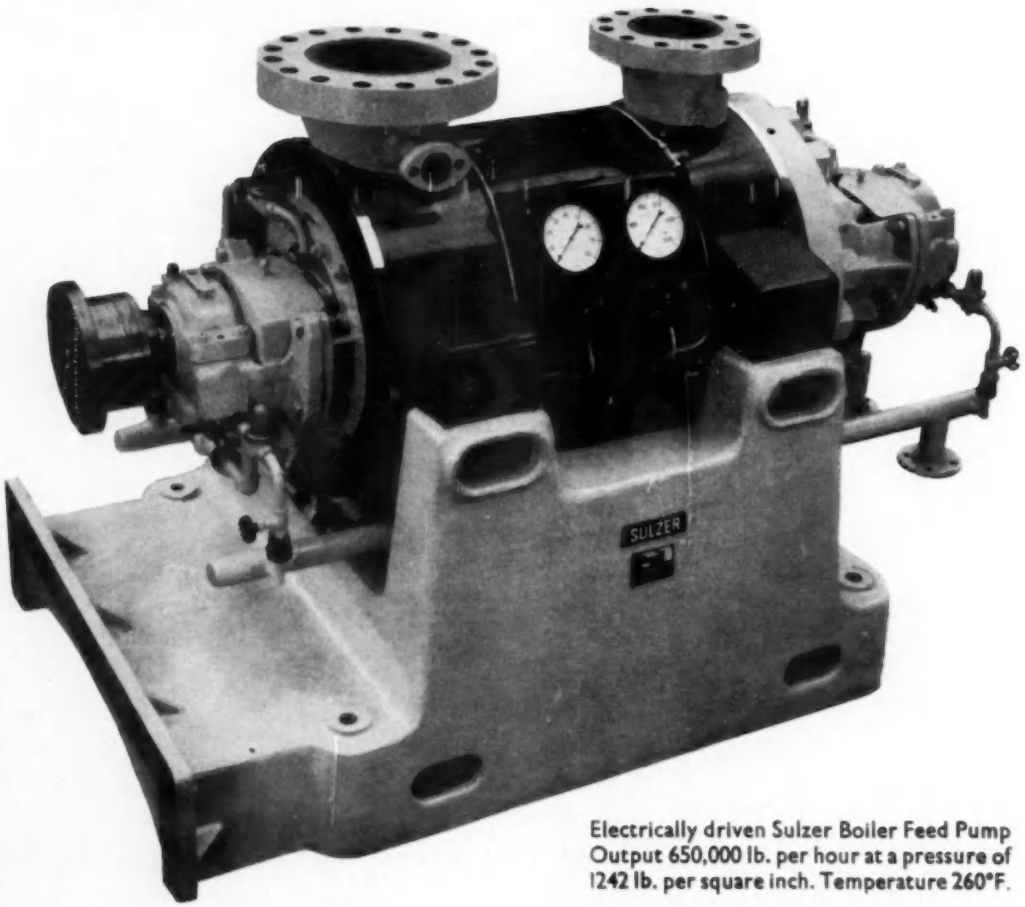
SULZER
BOILER - FEED PUMPS



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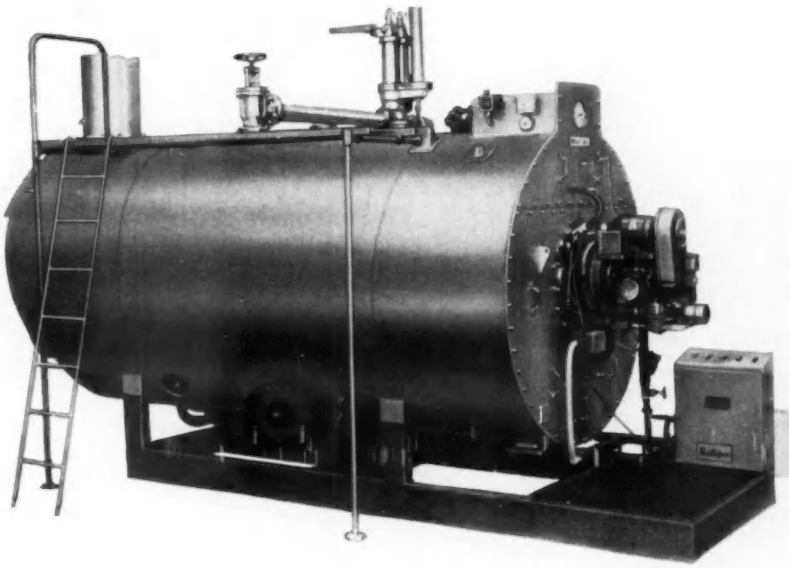

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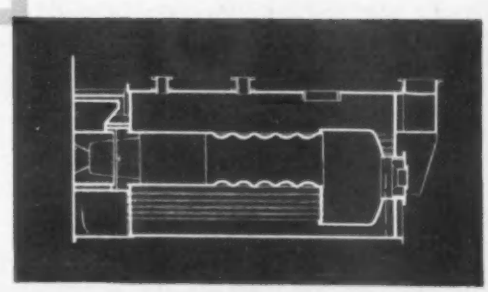

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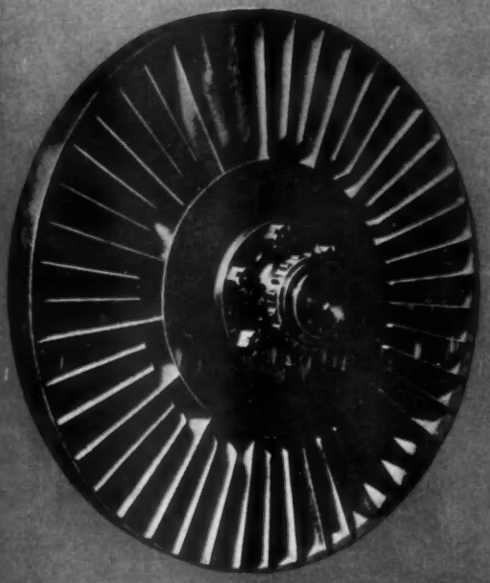

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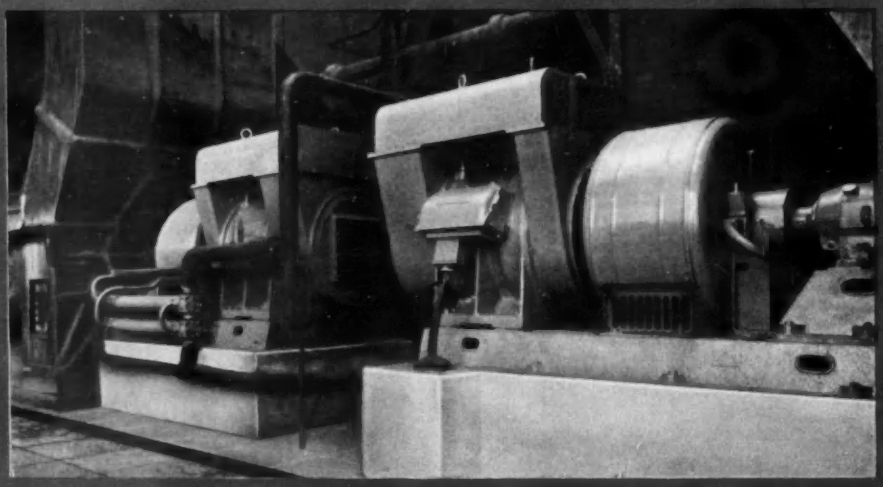

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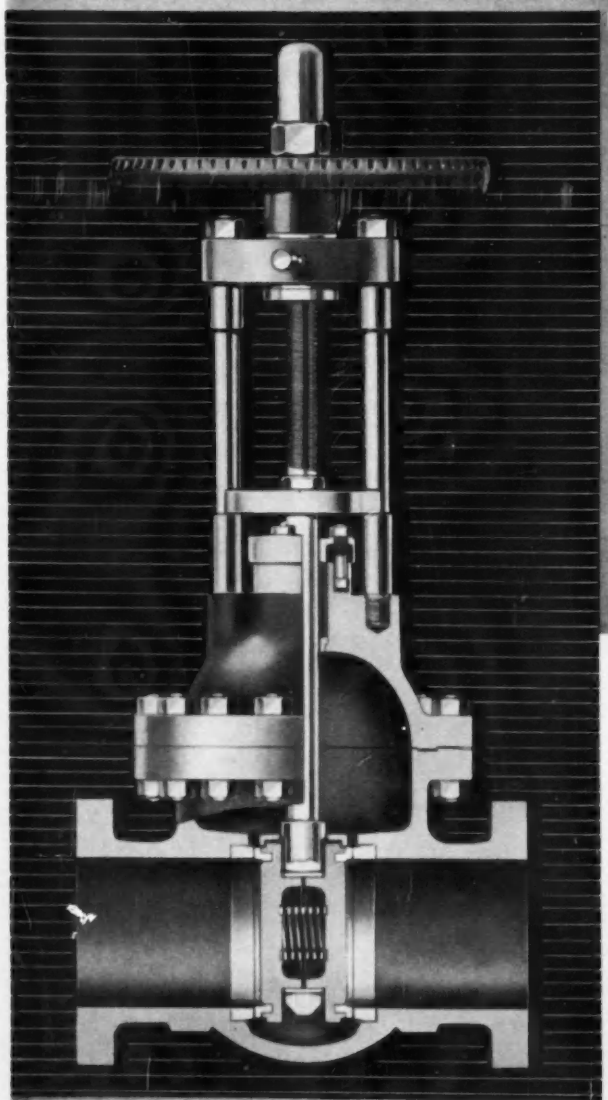

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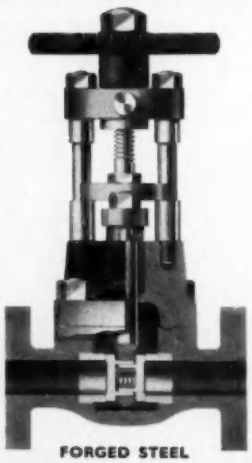

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Sizes . ¼" to 1½" Bore

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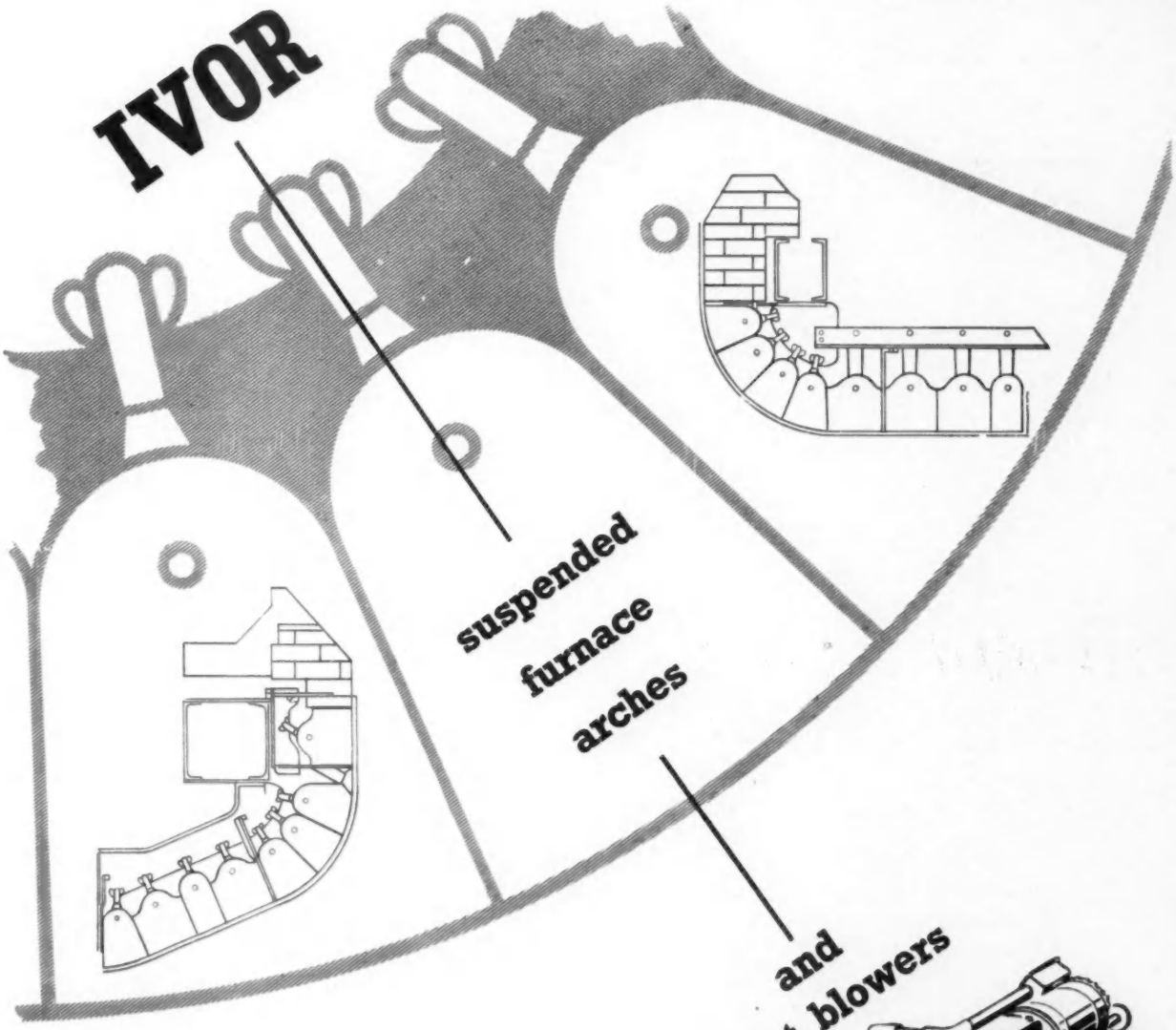

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Ivor Pendulum—suspended refractory arches
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clean heating surfaces without shutdown.
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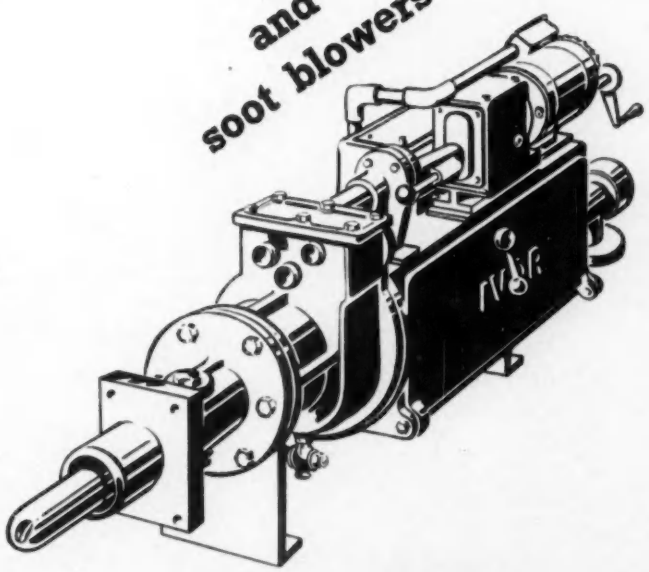

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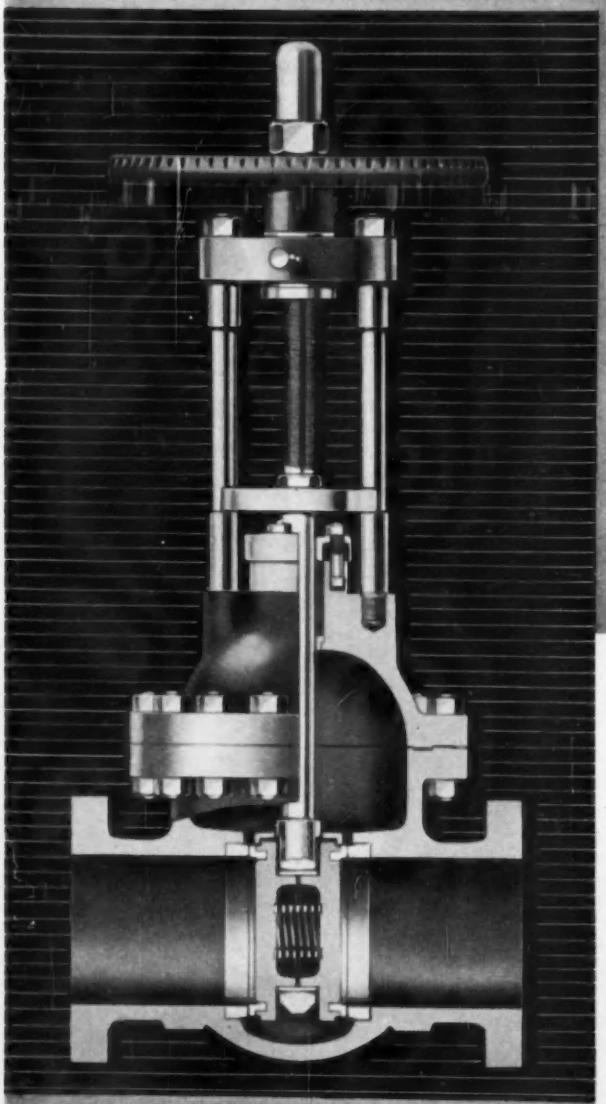

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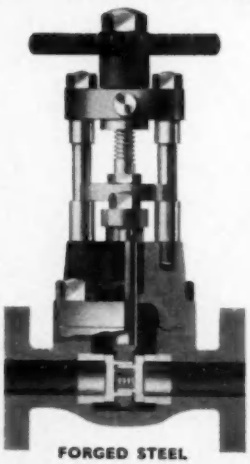
Sizes : 2" to 14" Bore



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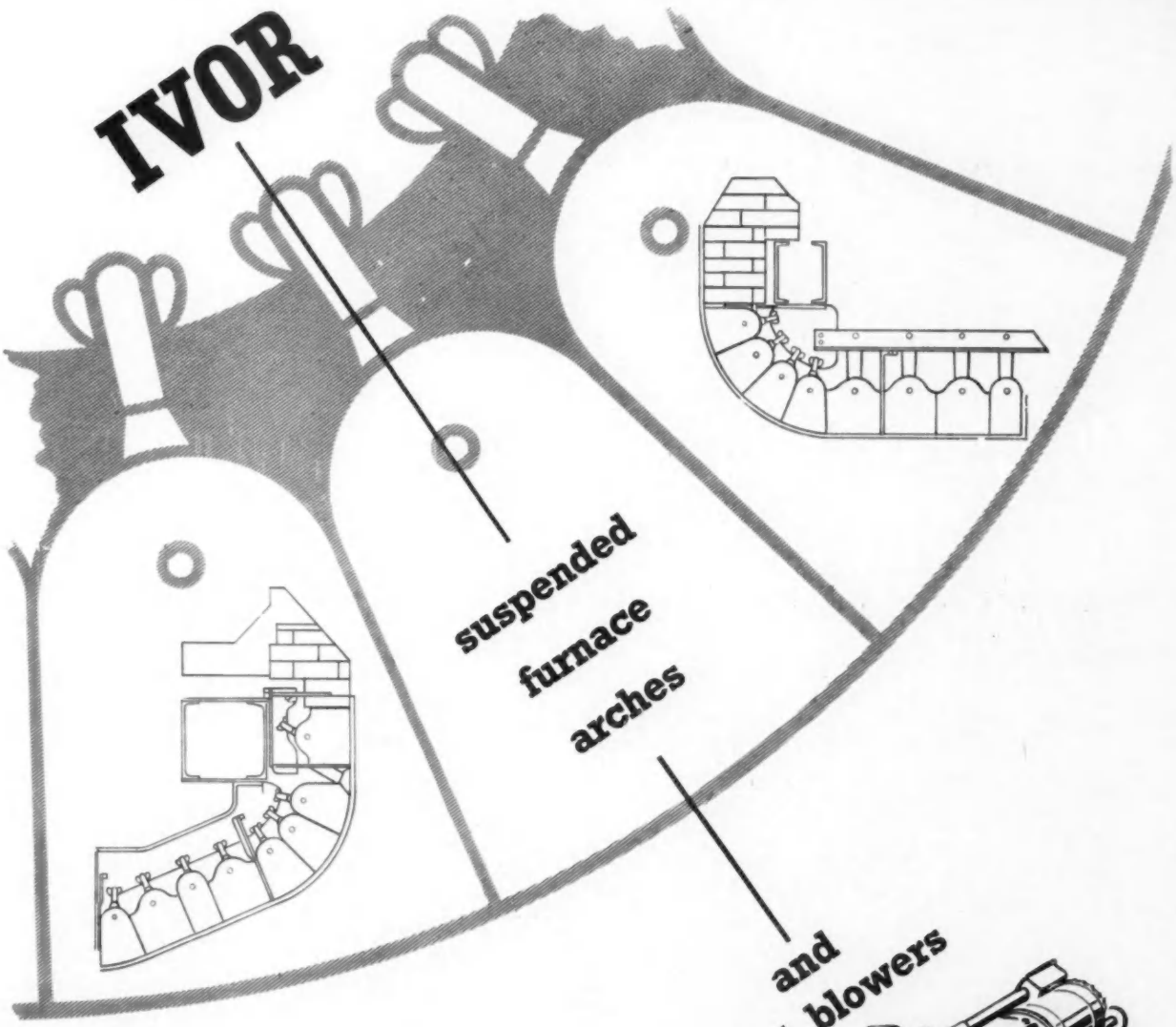

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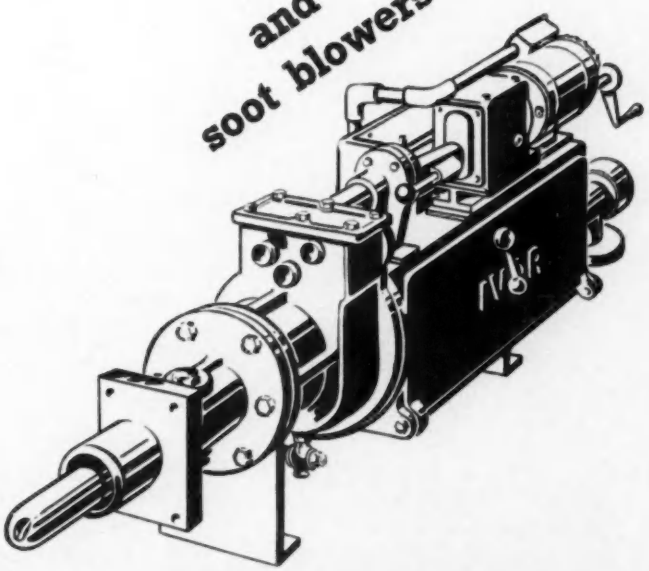

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A complete industrial power station by Simon-Carves

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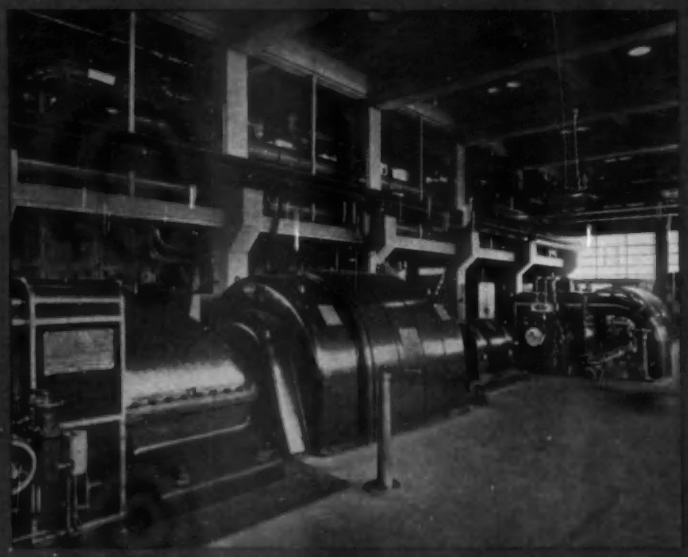
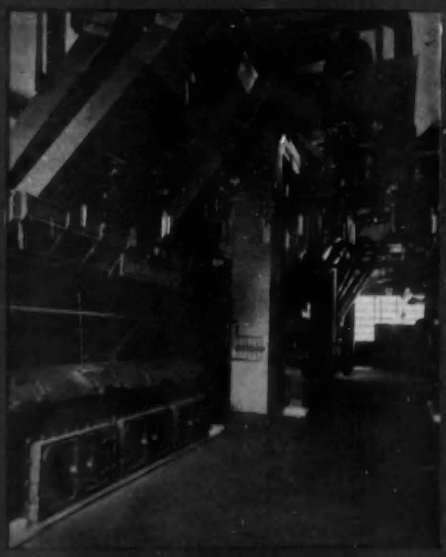
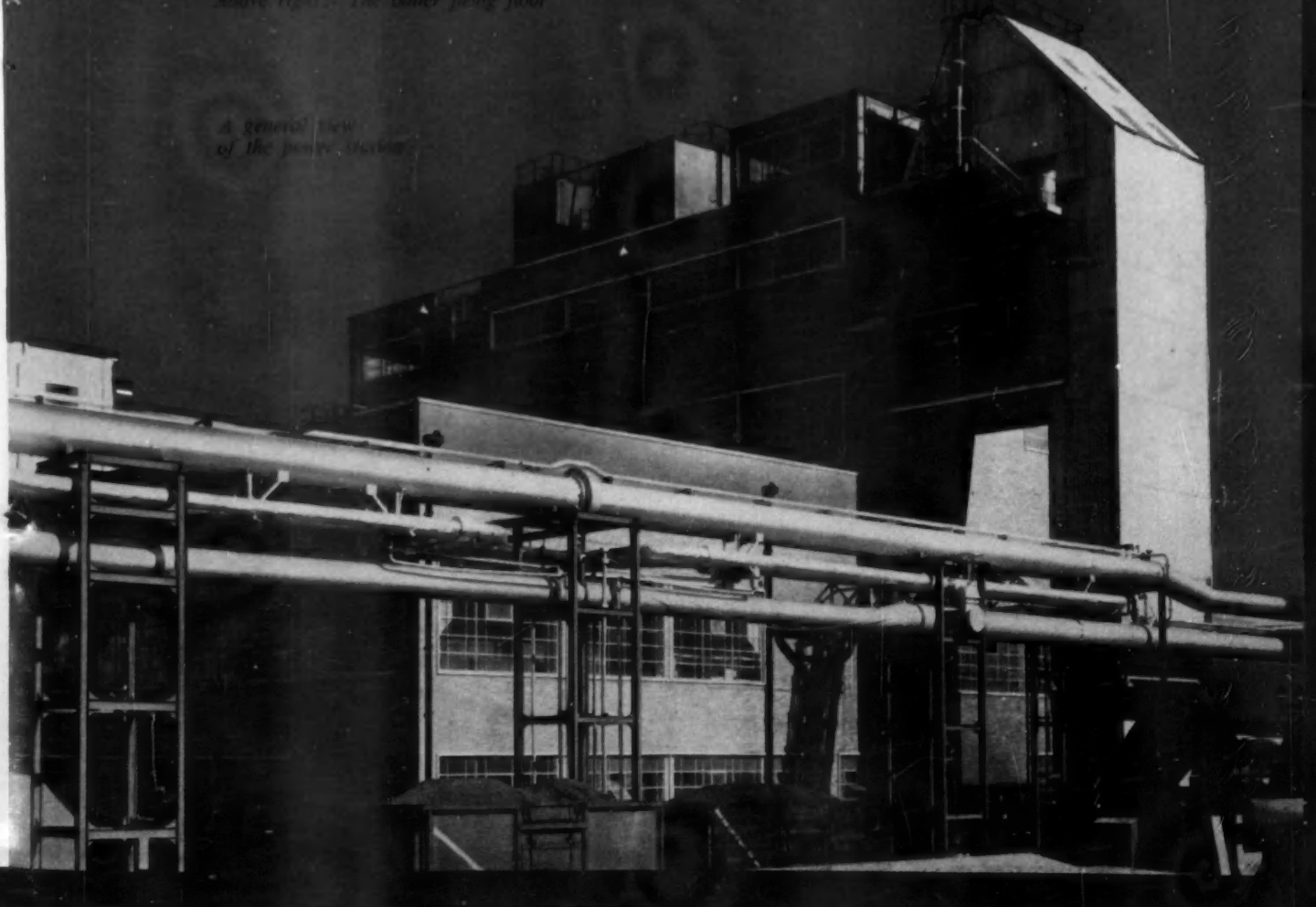




Above:- The turbo-alternators
Above right:- The boiler firing floor

A general view of the power station



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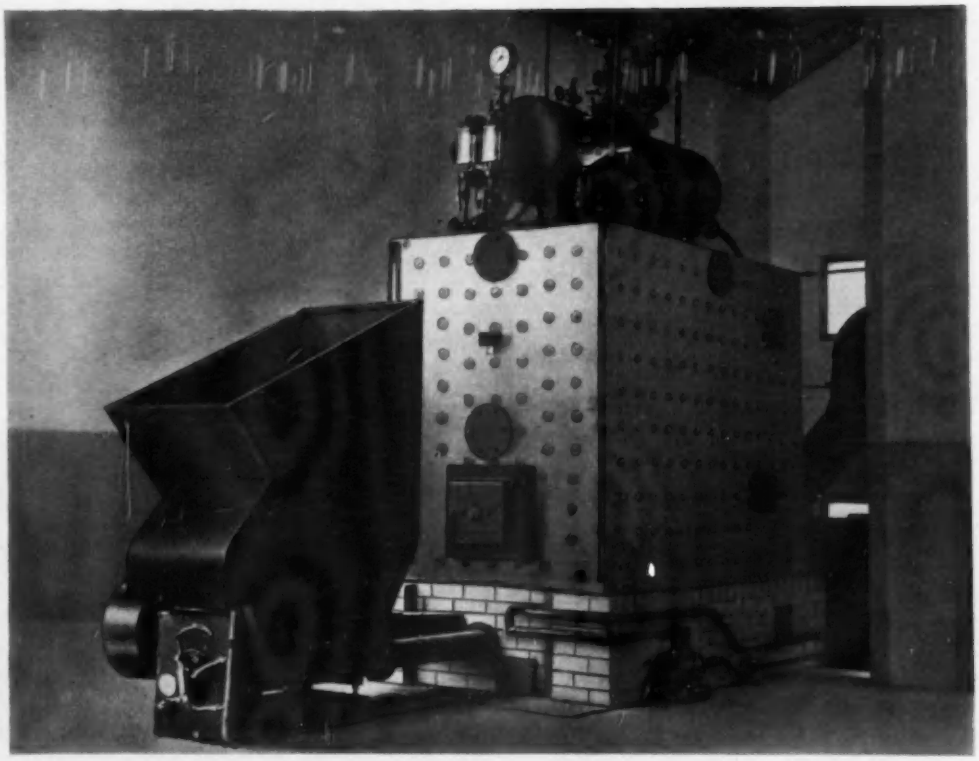

3,350 lb. per hr. 100 p.s.i. 'BS' Type Steam Boiler at the Convent of St. Louis, Monagahan, Eire. The unit is shown before application of lagging.

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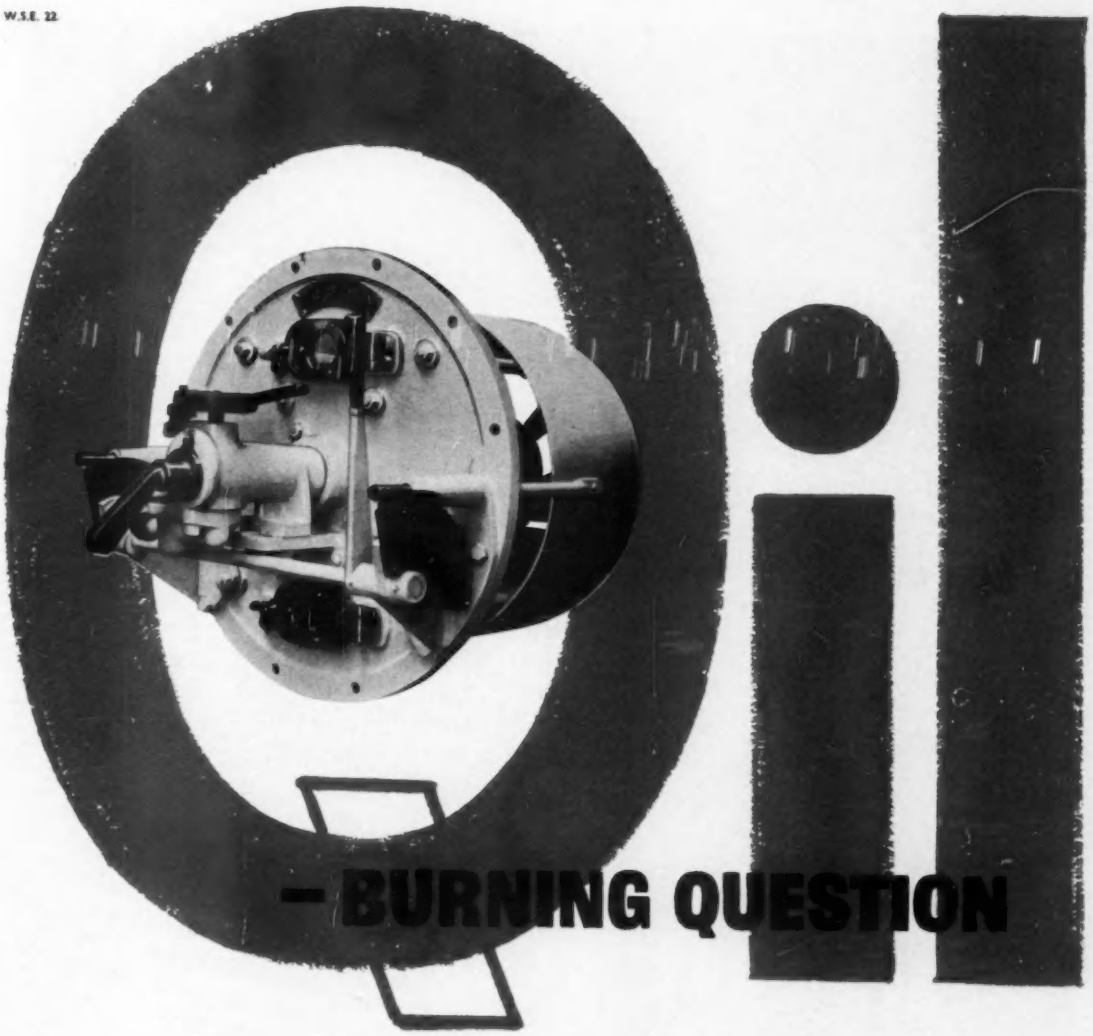

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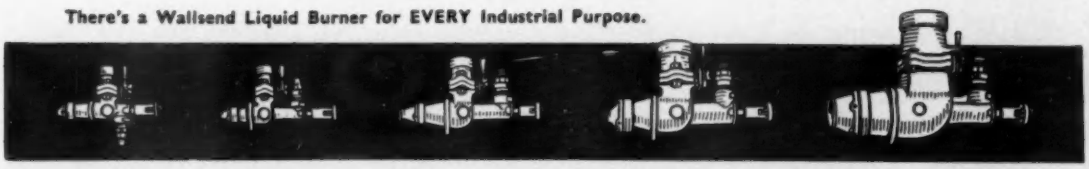

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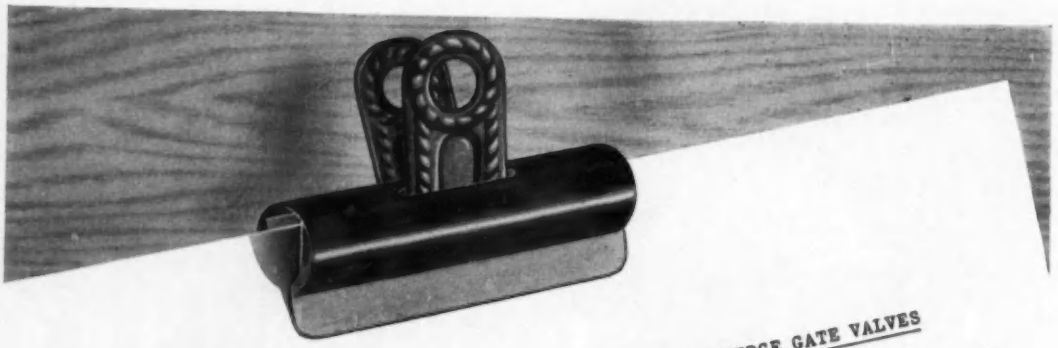

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...featuring this time the F.81

Specification: Bronze trim, rising stem. Flanged British Standard Tables "D" and "E" diameters. Working pressures: saturated steam up to 100 pounds. Water or oil (cold, non-shock) up to 200 pounds.

Besides the F.81. Crane, of course, make innumerable variants of this and other Cast Iron Gate Valves from 2" to 12". All have these features: long Disc Guides which seat Discs properly, minimise drag on seat faces, and prolong valve life. Shoulder type Seat Rings prevent rings from loosening. Two piece Ball-Type Gland prevents binding on stem—even when gland bolt nuts are pulled up unevenly. All are available in bronze trim or all-iron—with screwed or flanged ends (according to size)—with rising or non-rising stem. According to trim they are suitable for use with steam, water oil or gas services.

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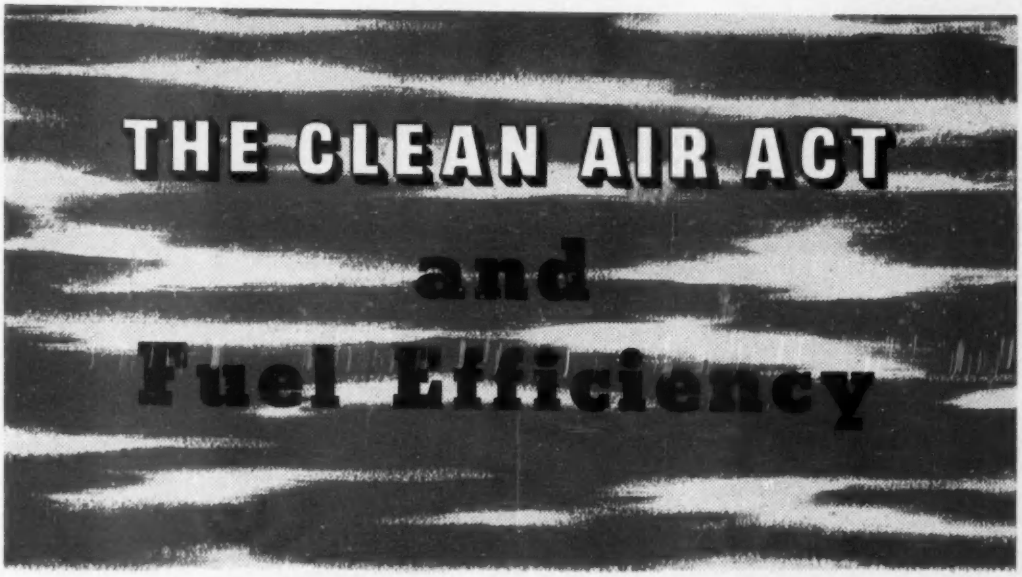

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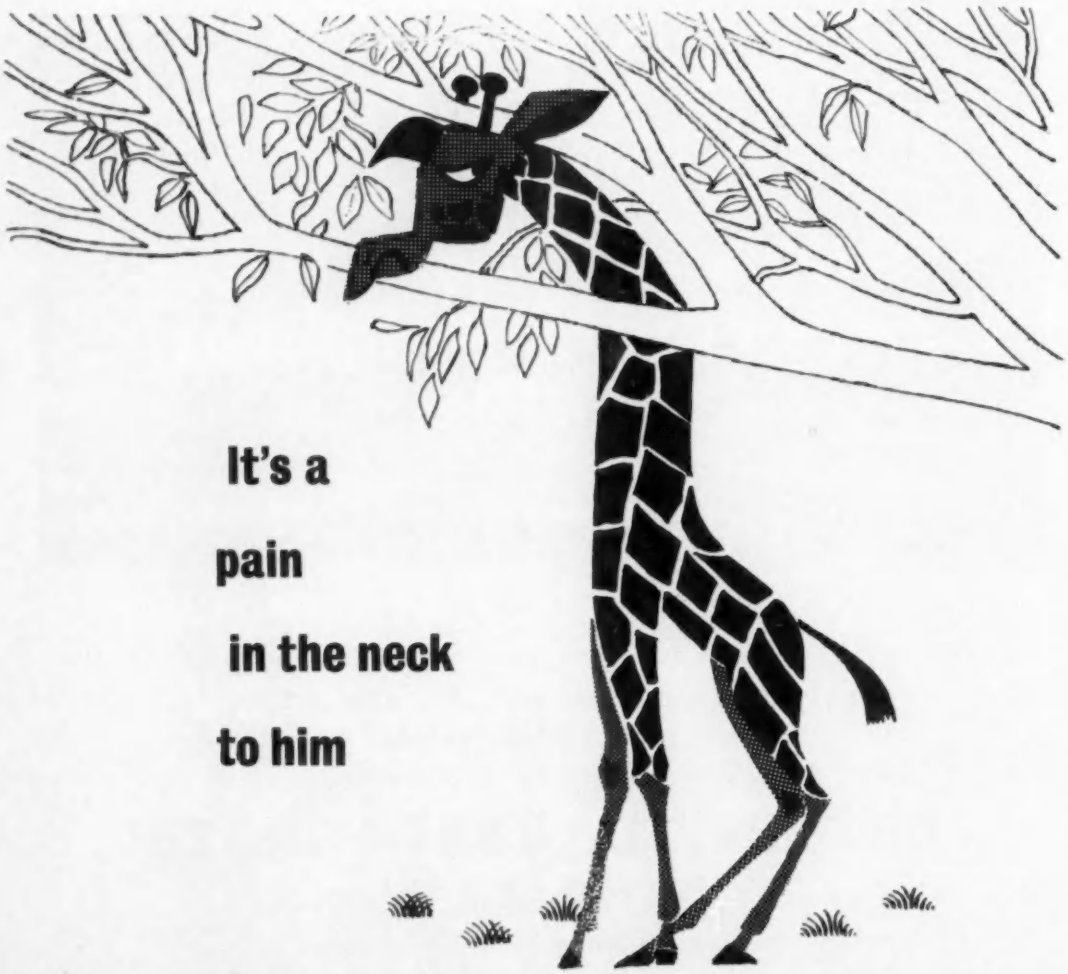

It's a pain in the neck to him

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But for cold-wet surfaces up to 125°F.—use "APEXIOR NUMBER 3"

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350°F

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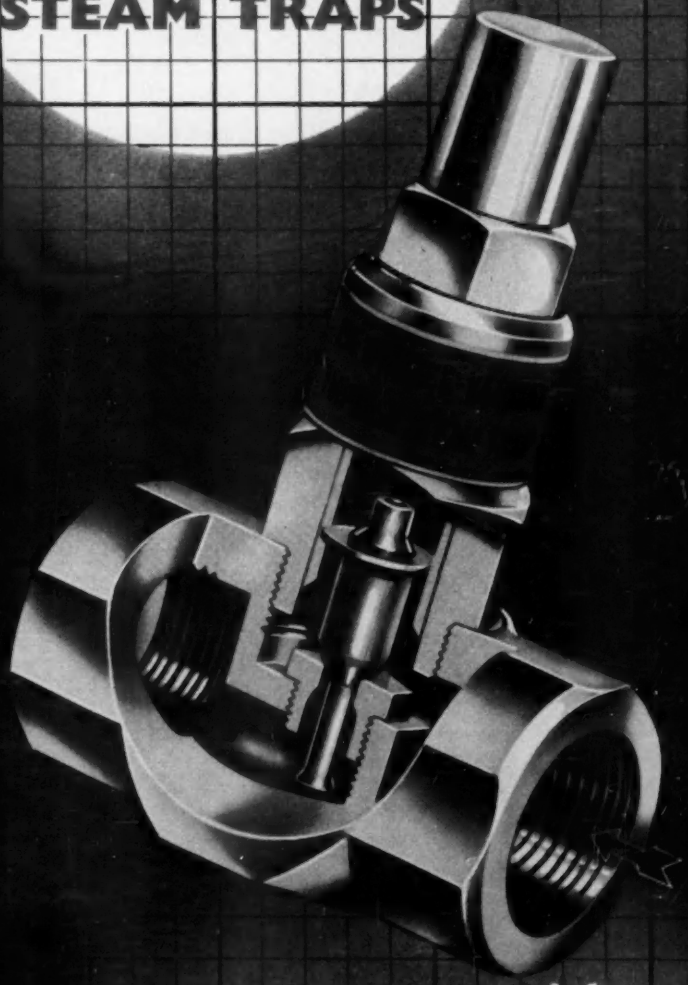
250°F

For even temperatures use DEWRANCE -YARWAY

STAINLESS STEEL IMPULSE STEAM TRAPS



Processes requiring careful temperature control call for Dewrance-Yarway Impulse Steam Traps on Steam equipment. The reason—these Traps maintain even temperatures because there is no arresting of flow or waiting for large quantities of condensate to accumulate. All condensate is discharged as soon as it is formed.

- Suitable for all pressures up to 400 lb/in² 842°F without change of valve or seat.
- Small size, light weight.
- Easy to install, easy to maintain.
- Stainless Steel.
- Only one moving part—the valve.
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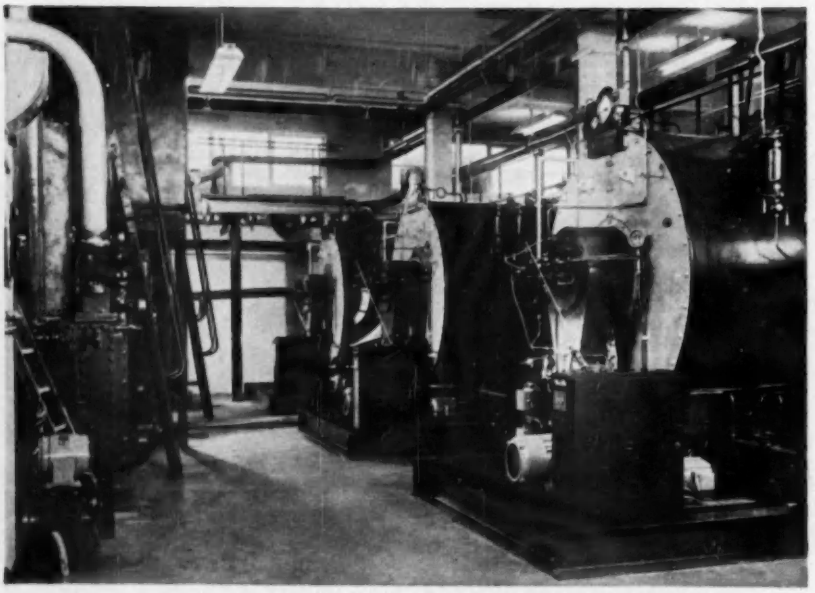

3 *STEAMBLOC MODEL 400 UNITS being part of a Steambloc Packaged Boiler installation supplied to the United Kingdom Atomic Energy Authority.*

Hundreds of "STEAMBLOC" fully automatic packaged boilers are giving satisfactory service at home and overseas to ADMINISTRATION COMMERCE and INDUSTRY

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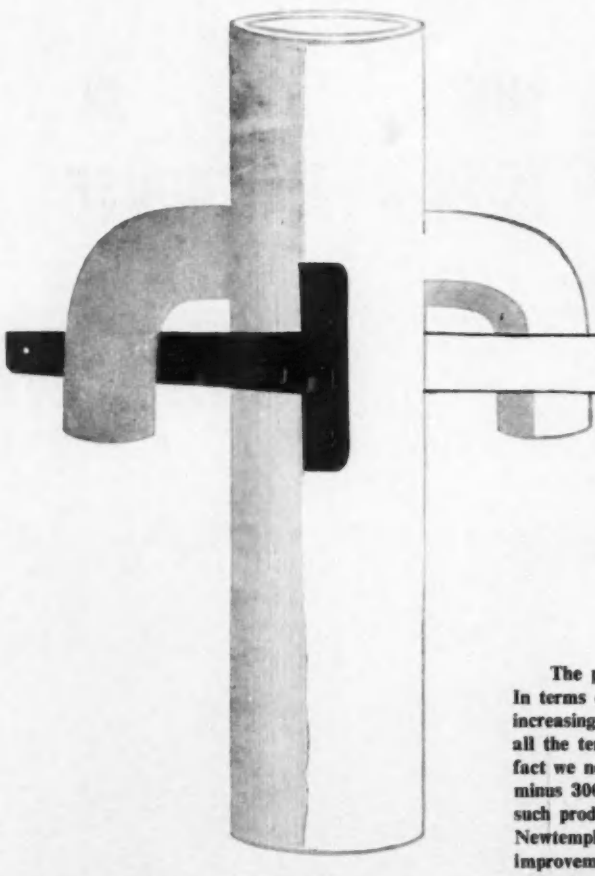

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The post-war period has seen much industrial expansion. In terms of thermal insulation this has meant an increasing demand for more efficient insulation to cover all the temperature ranges of present-day industry. In fact we now provide insulation for temperatures as low as minus 300°F up to over 2000°F. The development of such products as Newalls 85% Magnesia and Newalls Newtempheit Insulation has proceeded hand in hand with improvements in insulation practice. Experience in many large industrial contracts, coupled with the work of our Research Laboratories, has found us equal to any new problem. In many power stations, oil refineries, industrial power plants, large cold stores and chemical plants, you will find evidence of the wide experience we as the country's largest thermal insulation manufacturers and contractors, have built up in half a century of operation. Based on this experience we offer free consultation on any aspect of insulation.

This photograph shows NEWALLS (Regd. Brand) 85% Magnesia sections being applied to pipework.

Where there's a problem of insulation there's a job for

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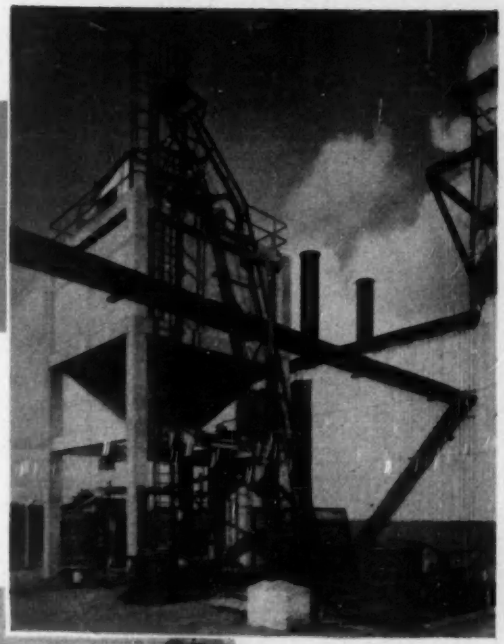

Ash handling from the discharge end of the conveyor to the storage hopper

In the John Thompson Ash Conveyor the ash from the boiler furnaces falls through water to a submerged belt conveyor. The ash is immediately quenched, and no dust can escape. The conveyor works at low speeds and requires very little power to drive it. Wear and upkeep are practically nil.

The discharge end of the submerged conveyor belt emerging from the trough.

The trough with submerged belt, showing the ash chutes from the boilers.

JOHN THOMPSON CONVEYOR COMPANY
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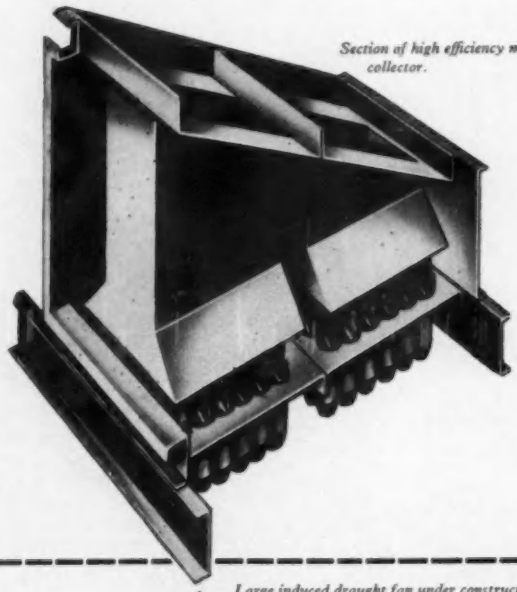

Section of high efficiency multitubular dust collector.

PD-KB

Large induced draught fan under construction, Arbroath Works.

for grit and dust collection and boiler draught

PD-KB — these are initials which have come to represent a wealth of experience in the manufacture of equipment both for trapping dust and grit and for mechanical draught. Now, as a result of close collaboration between the two firms associated with these initials:

PRAT-DANIEL (STANMORE) LTD., and KEITH BLACKMAN LTD.

we can offer with undivided responsibility the perfect combination of specialised plant for boilerwork and other industrial requirements comprising:

High efficiency MULTITUBULAR DUST COLLECTORS

ELECTROSTATIC PRECIPITATORS *

INDUCED and FORCED DRAUGHT FANS

(including the highly efficient Type AR aerofoil section bladed, centrifugal fans)

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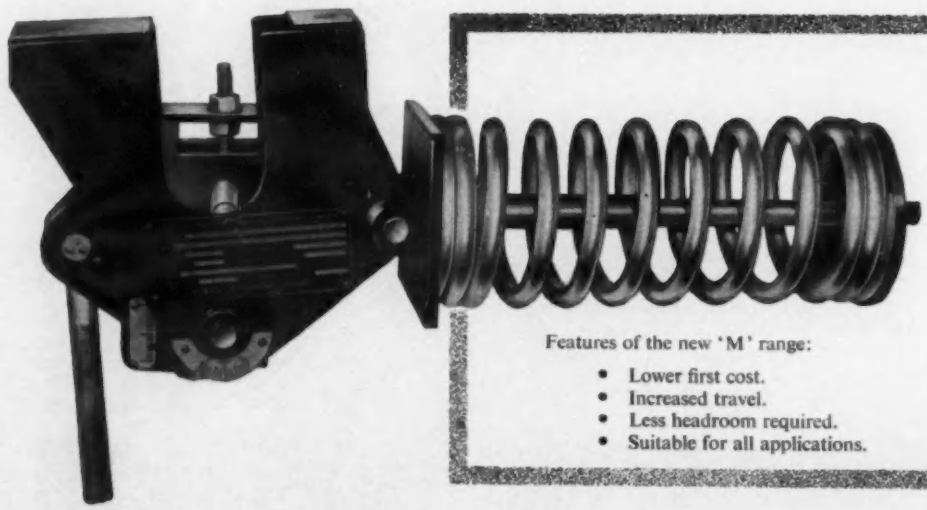
The Vokes Genspring 'M' range of Constant Support Hangers is the culmination of long, practical experience and laboratory research by Vokes' engineers. Originally designed for rugged marine use, the 'M' range is more economical, both in application and first cost, and more compact than existing types; it also requires less headroom. Together with the other Vokes Genspring Constant Support Hangers, the new 'M' range provides the solution to any pipe suspension problem. *If you would like to know more, please send for full details of both types of Vokes Genspring suspension systems.*

Vokes Genspring M range



Features of the new 'M' range:

- Lower first cost.
- Increased travel.
- Less headroom required.
- Suitable for all applications.

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Total Head in Feet	
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275	PUMP RPM BHP
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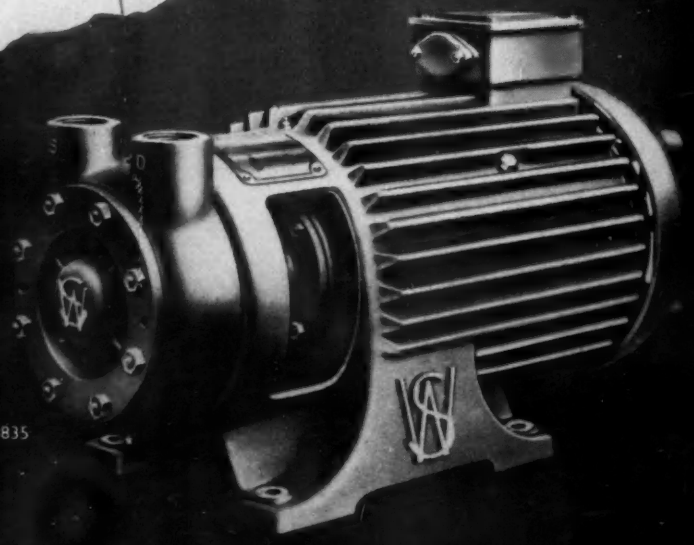
these heads on single stage pumping

A CHEAPER—SIMPLER METHOD OF PUMPING SMALL CAPACITIES AT HIGH HEADS FOR BOILER FEED SERVICE etc.



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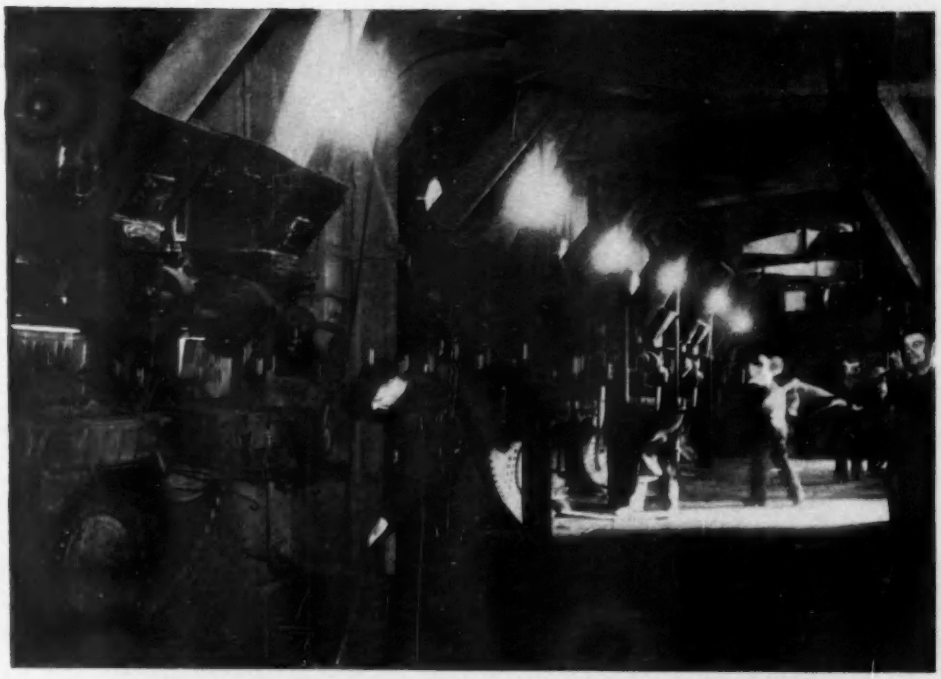

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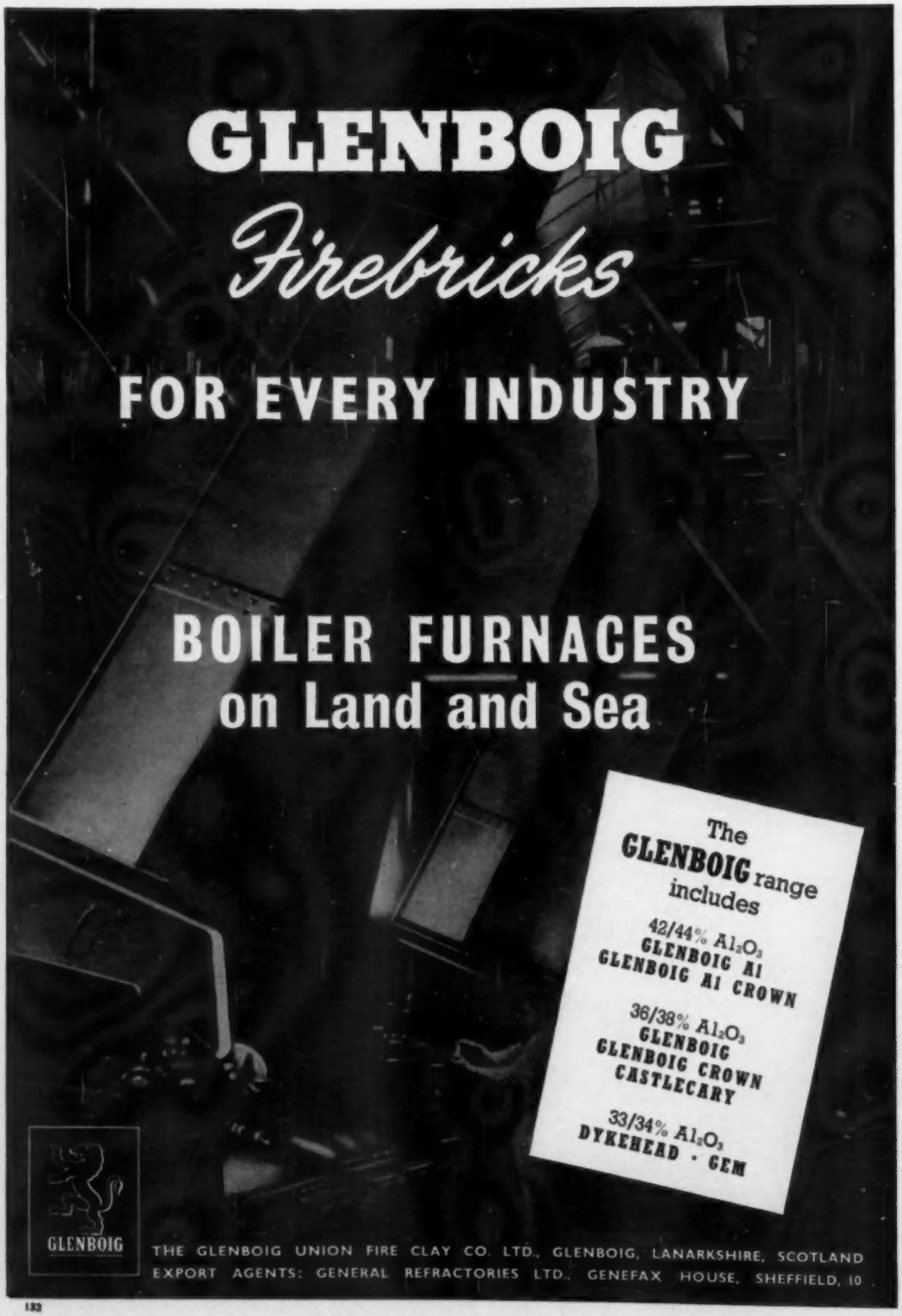
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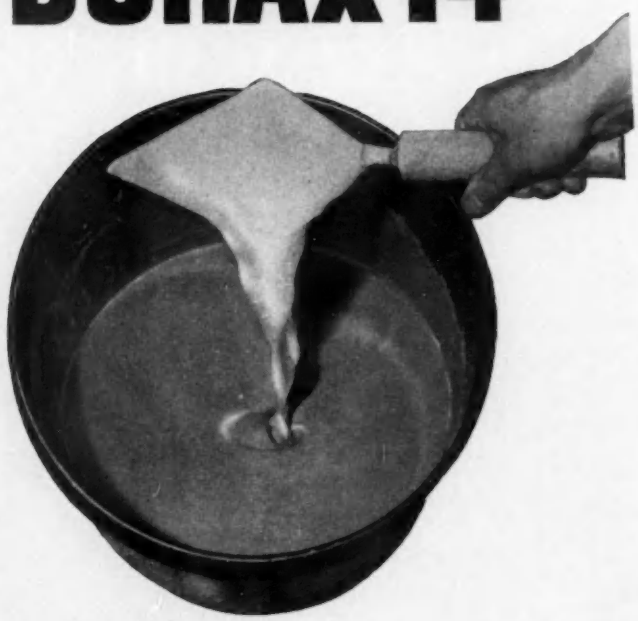
Plastic DURAX '14'

The *Time-Saving Way* to obtain THIN STRONG JOINTS



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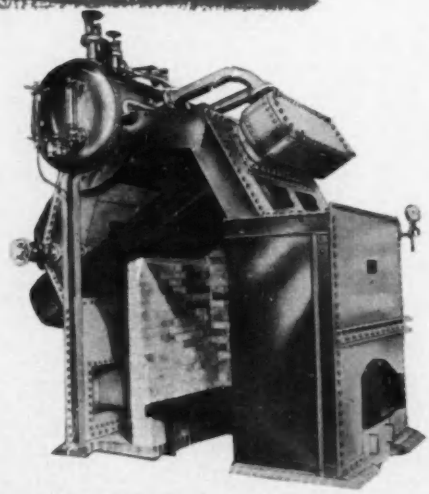
81·59% EFFICIENCY



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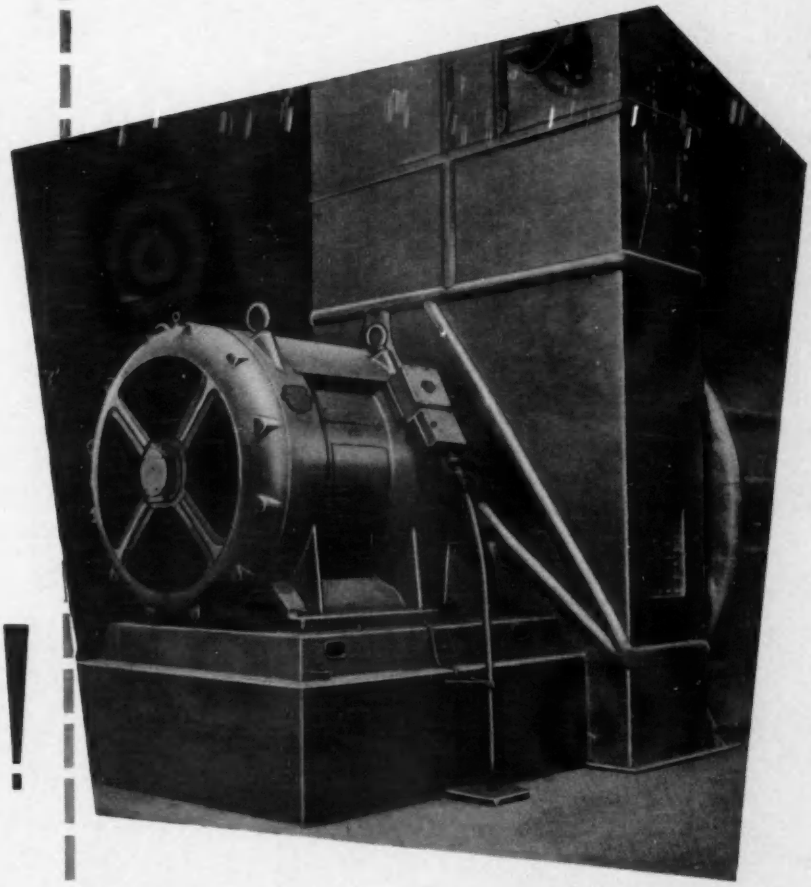

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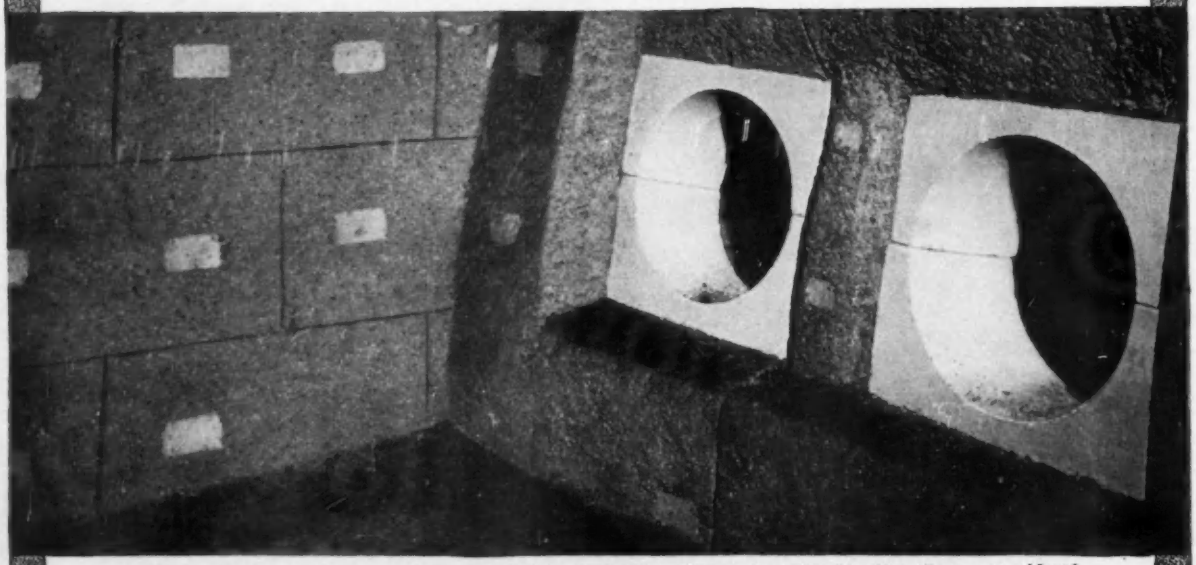

Front and side walls of a Queen Mary boiler in Tri-Mor High Temperature Mouldable, with MR 60 anchors. Burner quarls in Tri-Mor High Temperature Castable.

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TRI-MOR *Standard Castable*

A medium texture refractory having negligible shrinkage up to 1,350°C. Suitable for casting special shapes or for monolithic structures. Limiting service temperature 1,350°C.

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A similar refractory to Tri-Mor Standard Castable, but specially developed to have very high mechanical strength over the lower temperature range. Maximum service temperature 1,250°C.

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Suitable for face temperatures up to 1,600°C; has an extremely high resistance to thermal shock; used for cast in situ monolithic structures and for pre-cast refractory shapes; can be applied with a cement gun.

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A plastic refractory for use up to 1,650°C: low shrinkage and a high resistance to spalling. Supplied mixed to the correct consistency for installation.

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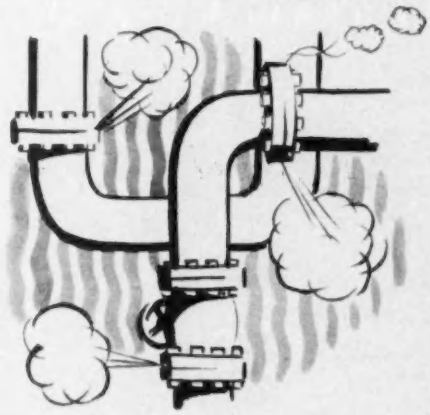

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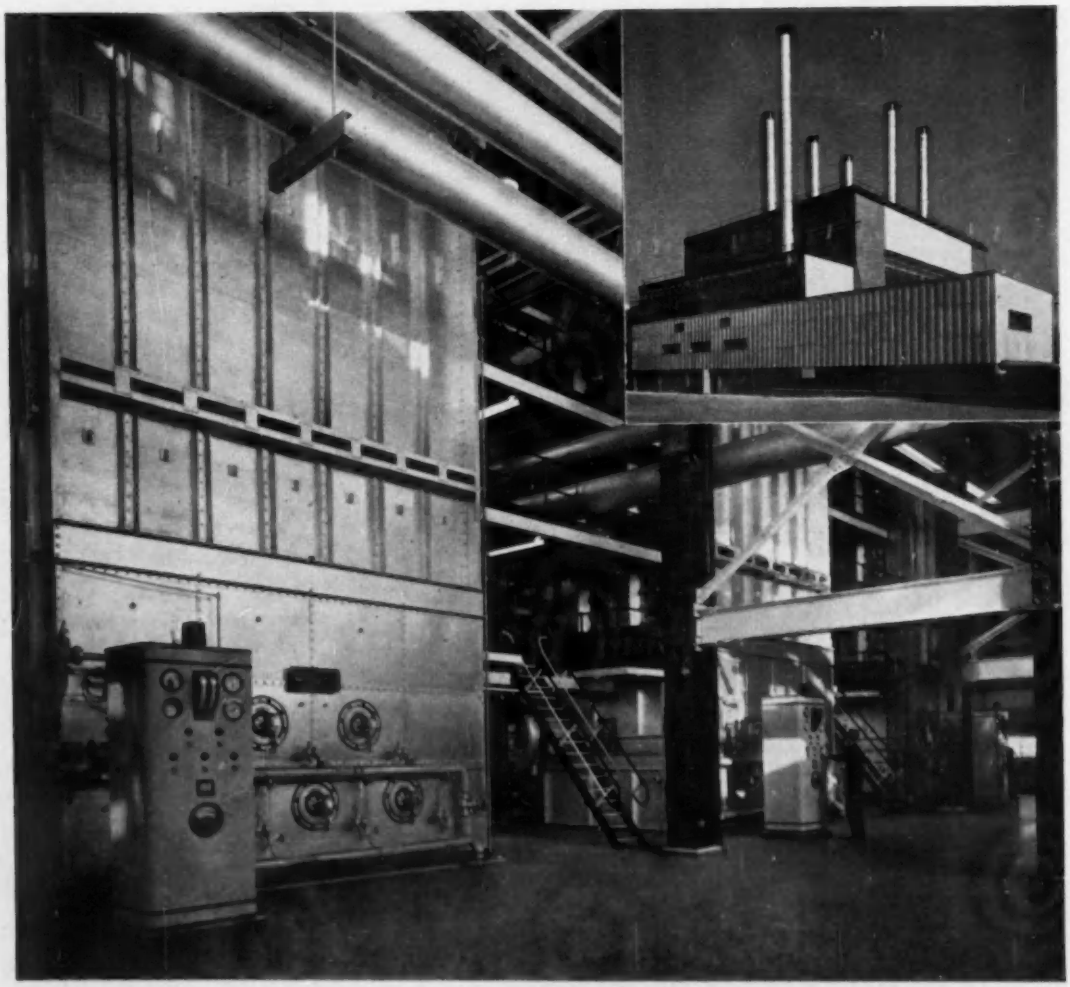
HAVE A GROSS INSTALLED CAPACITY OF

650,000,000 B.T.U's PER HOUR



View on firing floor, with exterior view inset, of the new A.C. Block Boiler House, an integral part of the new extensions at Luton Works

This plant, with 5—70,000,000 B.T.U. High Temperature Hot Water Boilers is the largest of its kind in the world.

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LEAKAGE

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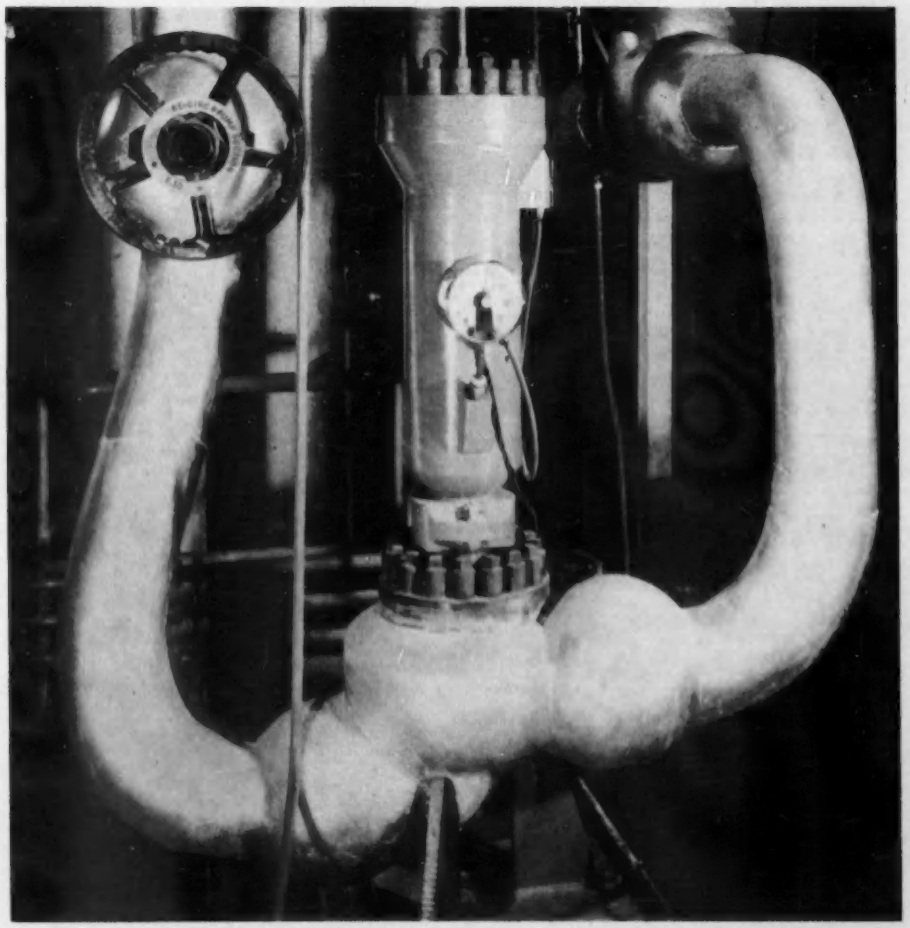
This unit was supplied to the order of Ewbank & Partners Ltd for the Central Electricity Generating Board to whom we are grateful for permission to publish this photograph.



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- CO-AXIAL DRIVE
- RATIOS UP TO 25:1
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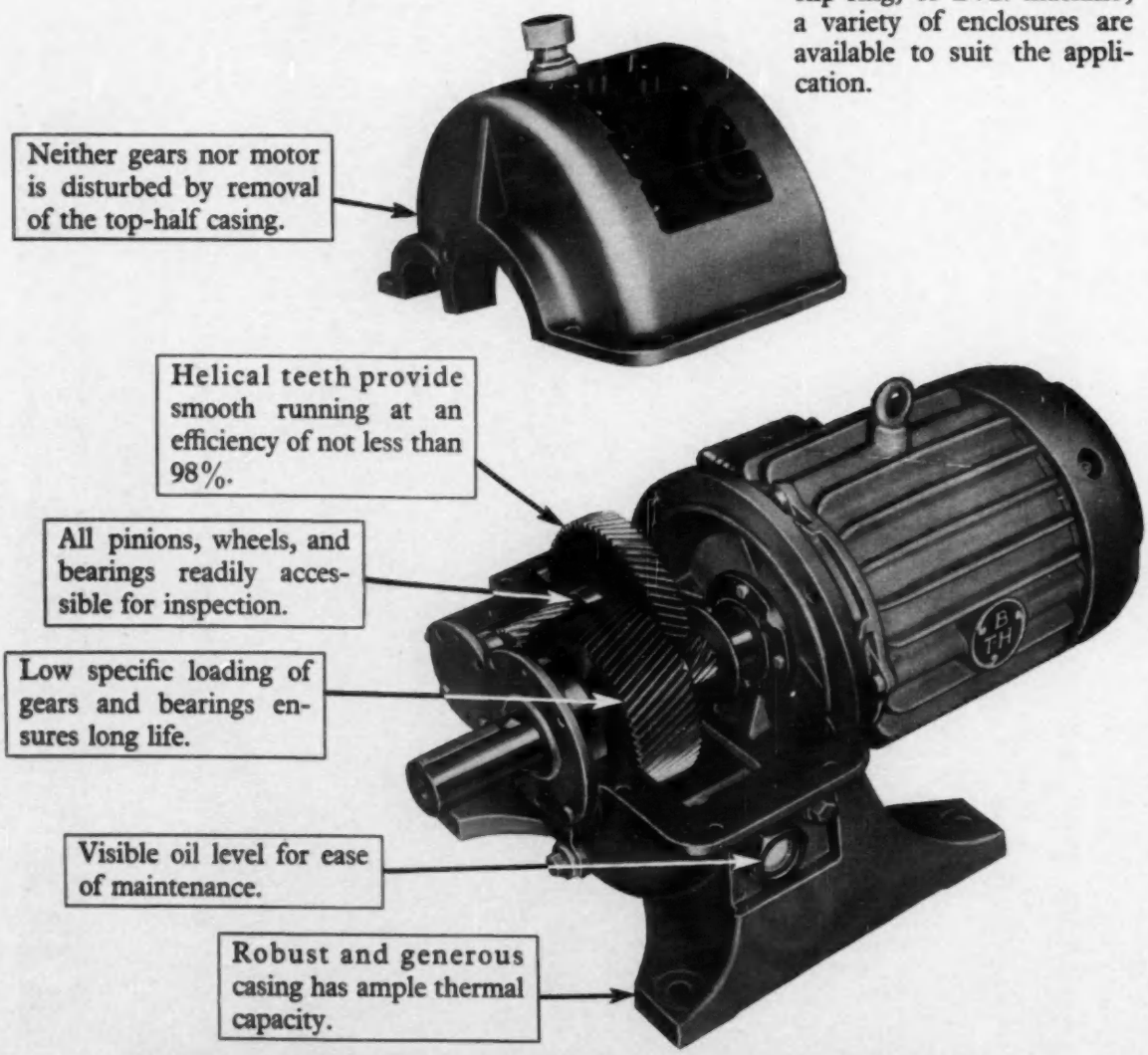
The motor component may be a squirrel-cage (including British Standard Dimension), slip-ring, or D.C. machine; a variety of enclosures are available to suit the application.


Neither gears nor motor is disturbed by removal of the top-half casing.
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An entirely new Spirax steam trap, working on the revolutionary but well-tested thermodynamic principle.

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THE SPIRAX THERMODYNAMIC TRAP:

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- is unaffected by superheat, waterhammer, vibration and corrosive condensate.
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Steam users will want to know more of a steam-trap which is so simple, robust, efficient and economical. The completed request slip will see to that.

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easily arrested at low cost

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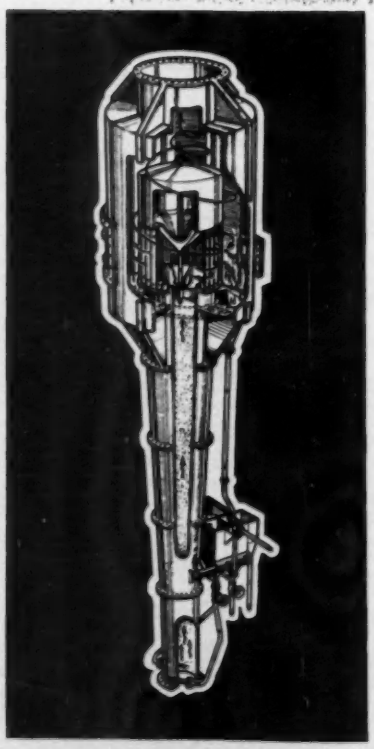

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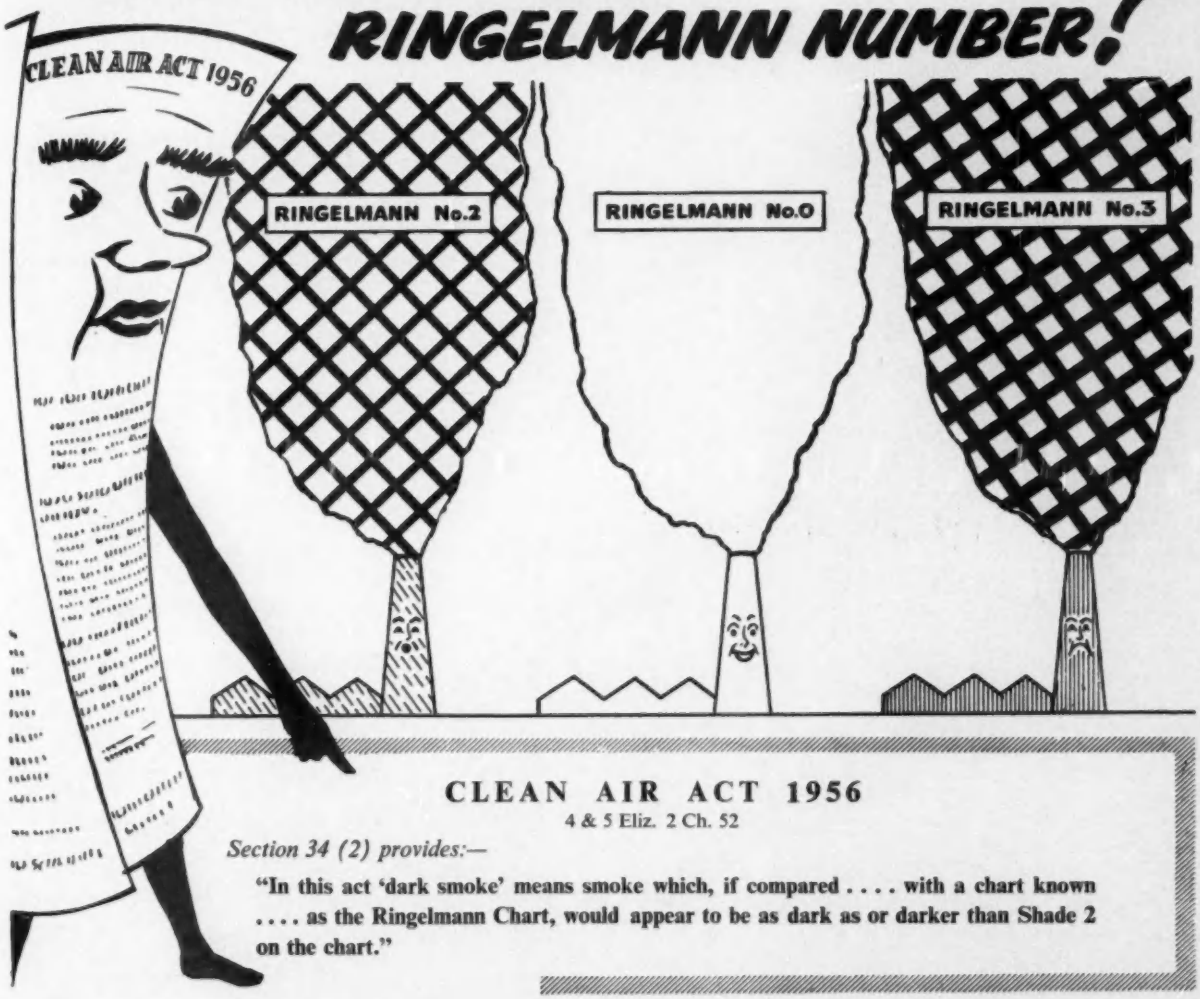
ONE OF THE DUNFORD & ELLIOTT GROUP

What is YOUR RINGELMANN NUMBER?



CLEAN AIR ACT 1956

4 & 5 Eliz. 2 Ch. 52

Section 34 (2) provides:—

"In this act 'dark smoke' means smoke which, if compared .... with a chart known .... as the Ringelmann Chart, would appear to be as dark as or darker than Shade 2 on the chart."

No. 3 RINGELMANN
IS A FLAGRANT OFFENCE UNDER THE ACT

No. 2 RINGELMANN
FAILS TO COMPLY WITH THE ACT

No. O RINGELMANN
IS ASSURED WITH THE

OLDBURY

CHAIN GRATE STOKER

which anticipated the Clean Air Act by 14 years

Today more than 5,000 Oldbury Stokers are serving industry, burning solid fuels in the widest variety, **EFFICIENTLY, SMOKELESSLY.**
Leave nothing to doubt. To comply with the Act, consult Edwin Danks at Oldbury or the nearest Branch Office.

EDWIN DANKS & CO. (OLDBURY) LTD.
OLDBURY near BIRMINGHAM · Tel: (Stoker Division) Brierley Hill 7731
LONDON · CARDIFF · GLASGOW · LEEDS · MANCHESTER · NEWCASTLE-ON-TYNE

WICKSTEED

REGD TRADE MARK

TUBE EXPANDERS

FOR ALL PURPOSES

As supplied to the Admiralty, Central Electricity Authority, Railways, Oil Refineries, leading Boiler Makers and Industrial users.

LEADING TUBE EXPANDER MANUFACTURERS FOR OVER 70 YEARS

CHARLES WICKSTEED & CO. (1920) LTD. KETTERING. Tel: Kettering 3113

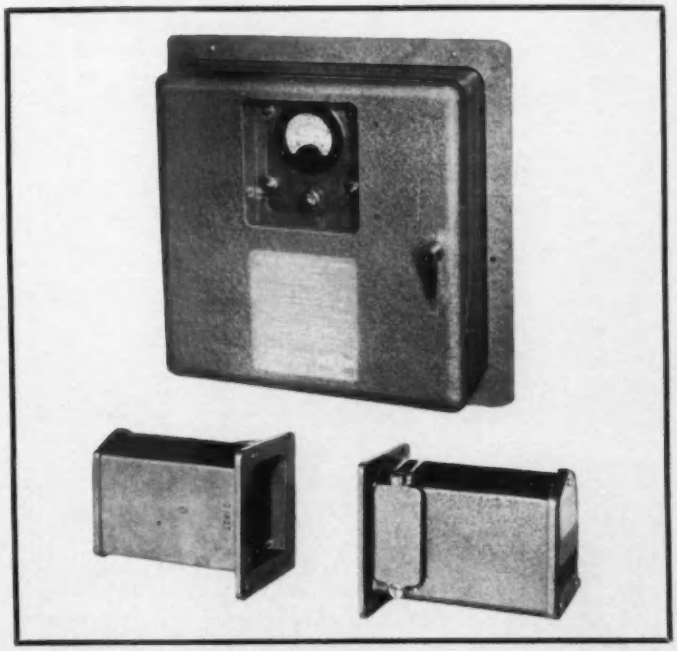
New Smoke Densitometer and Alarm complies fully with British Standards

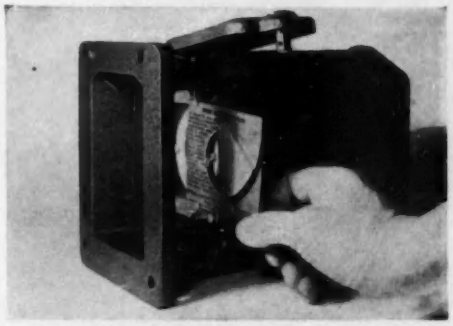
The Clean Air Act of 1956 calls for limitation of the emission of dark smoke (No. 2 Ringelmann or darker). This new Lancashire Dynamo smoke densitometer and alarm is not only an economical alarm unit which will ensure compliance with the Act but, by the addition of an indicator or recorder unit, it becomes a smoke densitometer for better combustion control and lower fuel costs.

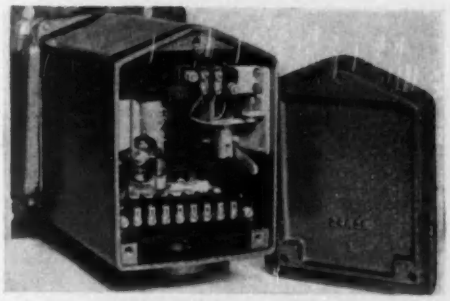
This equipment is the first of its kind to carry the British Standards Institution's "Kite Mark", which indicates independent certification of compliance with BS.2740/56 or, plus the appropriate indicating instrument, with BS.2811/57.

Note these Features

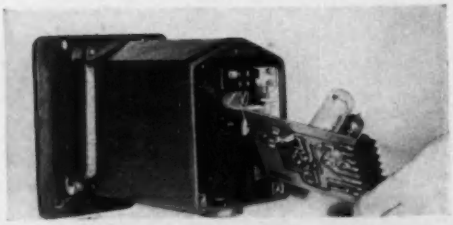
- **WEATHERPROOF CAST IRON HEAD UNITS WITH STAINLESS STEEL FITTING AND EASY ACCESS FOR LENS CLEANING.**
- **FULLY SERVO STABILISED LIGHT SOURCE PLUS "FAIL TO ALARM" CIRCUITS FOR CONSISTENT OPERATION.**
- **FULL RANGE OF ACCESSORIES INCLUDING CHIMNEY AND FLUE FITMENTS, INDICATORS, RECORDERS, ALARM BELLS AND HORNS, LENS CLEANING BLOWERS, SPECIAL CABLING AND MANY OTHERS.**

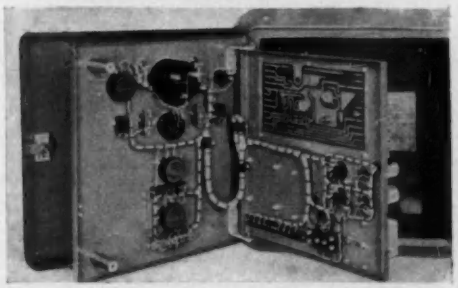






Calibration check by manual insertion of check slide or, in lower illustration of head with remote standardising unit, by push button from main unit.





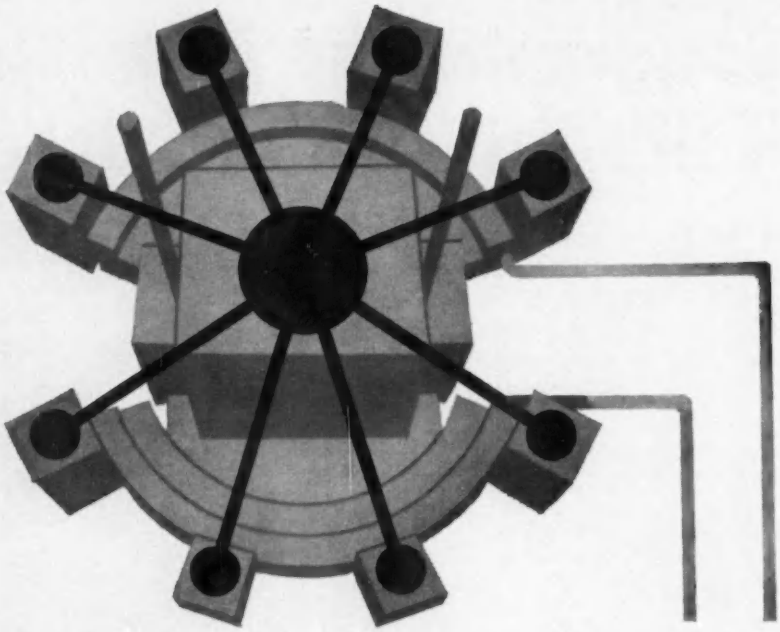
Printed circuit in main unit and head for ruggedness. Head unit circuit easily removed without disturbing mounting of unit on stack.

LANCASHIRE DYNAMO ELECTRONIC PRODUCTS LTD

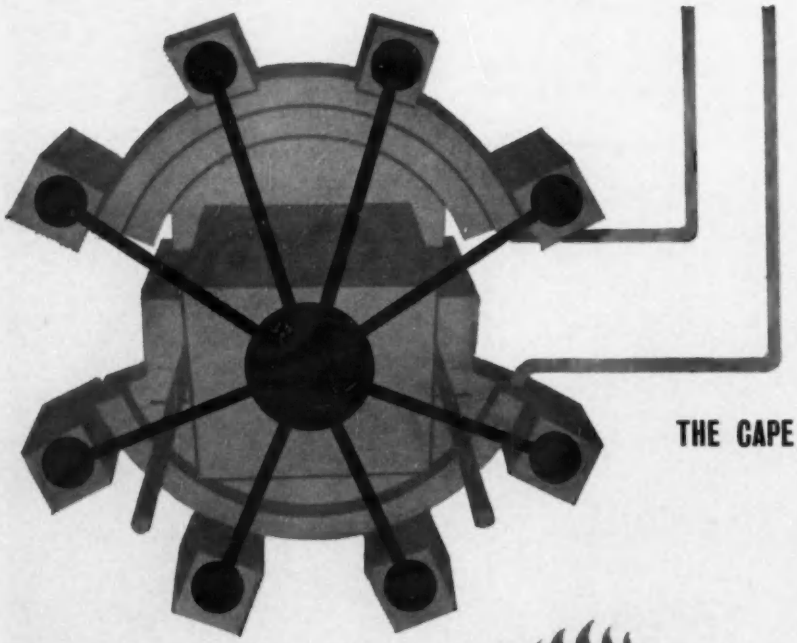
RUGELEY, STAFFORDSHIRE, ENGLAND

Manufacturers of Britain's widest range of industrial electronic equipment

One of the Lancashire Dynamo Group of Companies



BERKELEY—a challenge to insulation



The heat developed by the twin reactors of the new Berkeley atomic power station poses problems of thermal insulation which will require new techniques in their solution. Confining and controlling such intense yet precious thermal energy constitutes a challenge—a test worthy of the knowledge and skill acquired in 65 years' experience of thermal insulation manufacture by The Cape Asbestos Company, to whom the contract has been entrusted.

THE CAPE ASBESTOS COMPANY LIMITED

Manufacturers of:

CAPOSITE
Moulded Amosite Asbestos Insulation

ROCKSIL
Rock Wool Insulation

PLUTO
Asbestos Textiles

At the Berkeley Nuclear Power Station of the Central Electricity Generating Board, the contract for supplying and installing thermal insulation for the TWO REACTOR PRESSURE VESSELS, 16 HEAT EXCHANGERS, THE CO_2 DUCTING AND MAIN STEAM PIPES has been awarded by the main contractors AEI- John Thompson Nuclear Energy Co. Ltd., to The Cape Asbestos Company Limited.

CAPE

ASBESTOLUX asbestos insulation board, **MARINITE** asbestos sheet and **CAPASCO** moulded brake linings and clutch facings are also manufactured by the Cape Asbestos Group of Companies.

THE CAPE ASBESTOS COMPANY LIMITED

114 & 116 PARK STREET, LONDON, W.1. TELEPHONE: GROSVENOR 6022

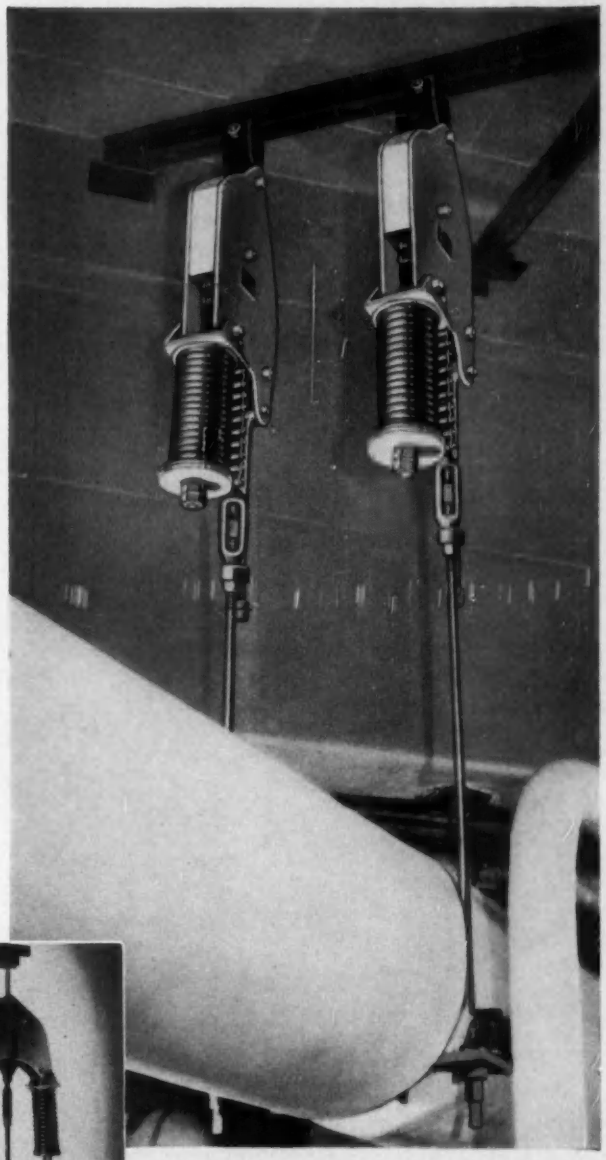
CON-TEN

constant tension supports

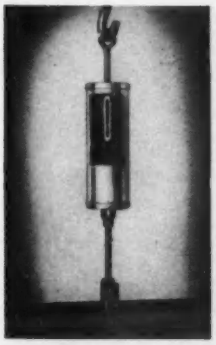
FOR LOADS UP TO 8 TONS
PIPE MOVEMENTS UP TO 18"

High-pressure steam piping is subject to wide variations in temperature, which produce considerable expansion and contraction. Unless the pipe supports can absorb and compensate for this movement, severe stresses are set up which may result in fracture. The " Con-Ten " Pipe Support is designed to cradle any type of piping with constant tension under all conditions, throughout the range of movement. " Con-Ten " is installed, with eminently satisfactory results, in power stations, and oil refineries, chemical and industrial plants throughout the world.

British Patent Nos. 474008 720074 720075 697987 657318
U.S.A. Patent No. 2129320

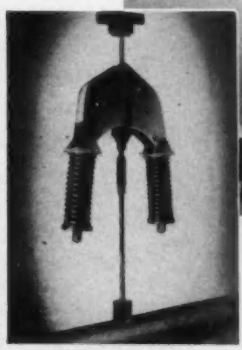


Ferrybridge " B " Power Station. Central Electricity Generating Board, Yorkshire Division. H.P. Steam pipes supplied and installed by Stewarts & Lloyds Ltd.



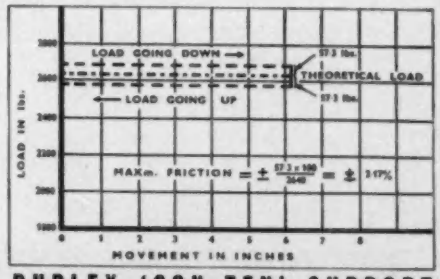
Leibfried Rod Top Pipe Supports for loads from 100 to 5,000 lbs. and total travel of 3".

Conventional type " Con-Ten " Supports for loads up to 2 tons with a total vertical movement up to 12".



Duplex " Con-Ten " Supports for load of up to 8 tons with a total vertical movement up to 12". This type is acknowledged as one which produces minimum friction and kinematic variation. It has been specially designed for any applications where exceptional accuracy is demanded.

From graph it can be seen that the maximum friction is equivalent to 2.17% of the applied load.

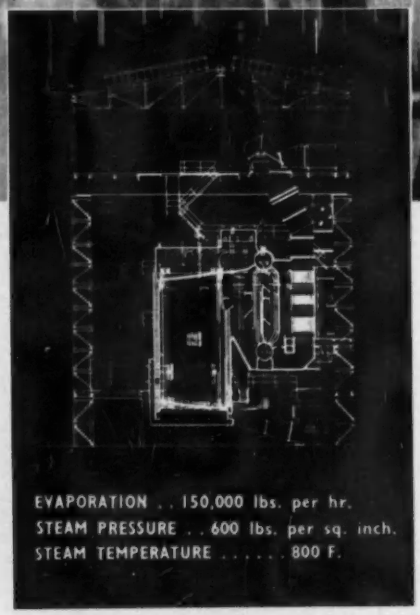


DUPLEX 'CON-TEN' SUPPORT

BRITISH INDUSTRIAL

ENGINEERING COMPANY LIMITED

CORONATION WORKS, HAINGE ROAD, TIVIDALE, TIPTON, STAFFS.

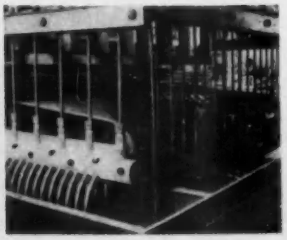


EVAPORATION . . 150,000 lbs. per hr.
STEAM PRESSURE . . 600 lbs. per sq. inch.
STEAM TEMPERATURE . . . . . 800 F.

OIL FIRED BOILERS for Thames Board Mills Ltd.

LARGEST MANUFACTURERS OF BOARD IN THE BRITISH ISLES

TWO BI-DRUM radiant heat oil-fired units are being installed in the Warrington Mill of the above Company, additional to two coal-fired boilers already supplied. The boilers have fusion welded drums, superheater economiser and balanced draught plant and integral de-superheater for steam temperature control, together with fully automatic boiler control. The contract includes oil-firing equipment, main steam, feed and blow-down pipework.



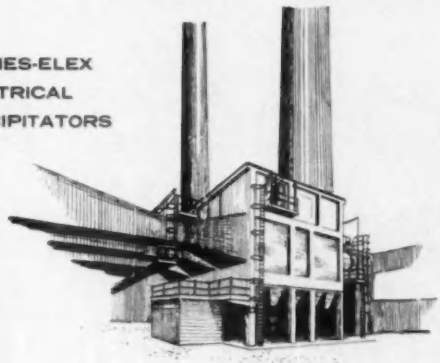
Clarke Chapman STEAM GENERATING PLANT

CLARKE, CHAPMAN & CO. LTD., VICTORIA WORKS, GATESHEAD, 8, CO. DURHAM. London Office: DUNSTER HOUSE, MARK LANE, E.C.3.
Glasgow Office: 116 HOPE STREET, GLASGOW, C.2. Manchester Office: 8 KING STREET, C.2.

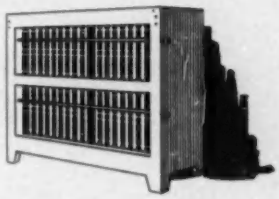
DUST COLLECTION AND CONTROL PLANT

Which system will solve your problem?

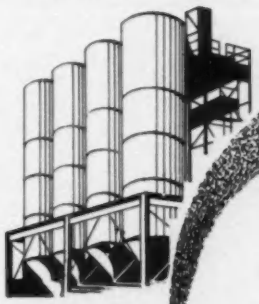
HOLMES-ELEX
ELECTRICAL
PRECIPITATORS



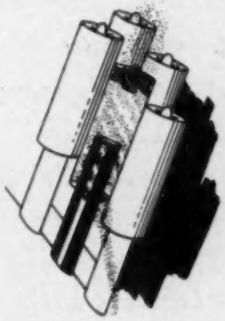
TRION
ELECTRONIC
AIR FILTERS



HOLMES-SCHNEIBLE
MULTI-WASH SYSTEM



HOLMES-ROTHEMUHLE
MULTI-CELL CYCLONE
DUST COLLECTORS



This **FREE** brochure will help you decide

As specialists in all kinds of dust collection and control plant, we are able to recommend the most suitable equipment for your particular conditions. Our experience in this field is backed by comprehensive laboratory facilities where your technical problems can be thoroughly investigated. Write or 'phone now for **Publication No. 72/24** which outlines the various types of plants available.

W · C · HOLMES & CO · LTD
(GAS CLEANING DIVISION)
TURNBRIDGE HUDDERSFIELD

Huddersfield 5280 Birmingham: Midland 6830. London: Victoria 9971

soot blowing

is a push-BUTTON job

with the NEW CLYDE system

UNIFIED LECTRAMEK CONTROL SYSTEM

most efficient yet devised.

Considerable savings in initial cost and valuable boiler room space have been achieved by this new system of electrical control which works in conjunction with the Clyde Lectramek Soot Blower * - the original blower employing a uni-directional motor. Control is exercised from a small panel which indicates all essential information to the operator.

Further information is given in our publication No. CBL. 1954 which will be supplied on application.

THE BLOWER: The complete operating cycle is in one motion and is driven through a compact mechanism by a non-reversing motor. When the operating shaft is rotated, the nozzle advances, the steam ports open and, at the same time, rocking motion is automatically transmitted to the nozzle. The uni-directional motor eliminates the bulky contactor gear used with reversing motors and reduces electrical maintenance by being of simpler and more rugged construction.

The reversing motion is achieved *mechanically* on all Lectramek blowers. A limit switch mounted on the gear box and connected to the starter regulates the stopping, starting and number of strokes.

AND THE CONTROL PANEL Simple controls to operate the automatic sequence are grouped on this small unit which takes up little space on the main boiler control panel.

CLYDE

CLYDE BLOWERS LTD · CLYDEBANK · SCOTLAND · Tel: Clydebank 2161/4

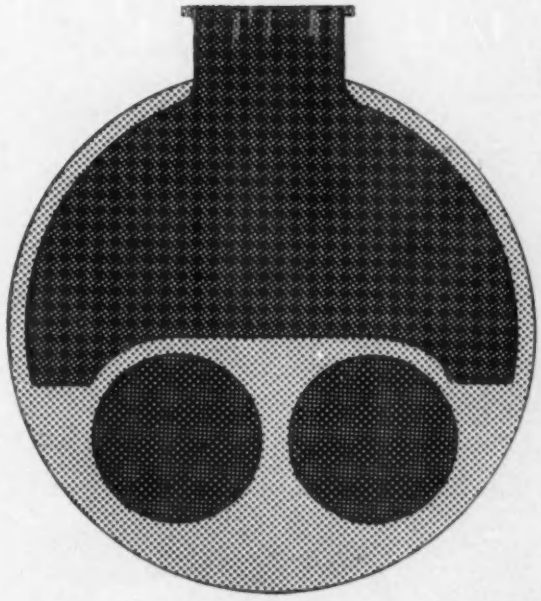
* *Over 5,000 blowers of this type in use all over the world.*

The Richardsons Westgarth Economic Boiler

Among shell boilers the Economic design holds pride of place. It has a high thermal efficiency, is flexible, requires only the simplest ancillary equipment, may be fired with an immense variety of fuels . . . these and others are merits of Economic boilers as a class.

The Richardsons Westgarth Economic boiler is simply an economic boiler made with the attention to detail that ensures a long and trouble-free life; and that by a company with immense experience of steam-raising plant of all kinds. Naturally, it meets the requirements of the relevant British Standard Specifications and of the Insurance companies.

The range extends from 3,000 to 20,000 lbs/hour. Up to 10,000 lbs/hour boilers may be either rivetted or welded; above this capacity all boilers are rivetted.



THE RICHARDSONS WESTGARTH GROUP

Co-ordinating the land and marine activities of

THE NORTH EASTERN MARINE ENGINEERING CO. LTD.

RICHARDSONS WESTGARTH (HARTLEPOOL) LTD.

PARSONS MARINE TURBINE CO LTD.

THE HUMBER GRAVING DOCK & ENGINEERING CO. LTD.

GEORGE CLARK & NORTH EASTERN MARINE (SUNDERLAND) LTD.

RICHARDSONS WESTGARTH ATOMIC LTD.

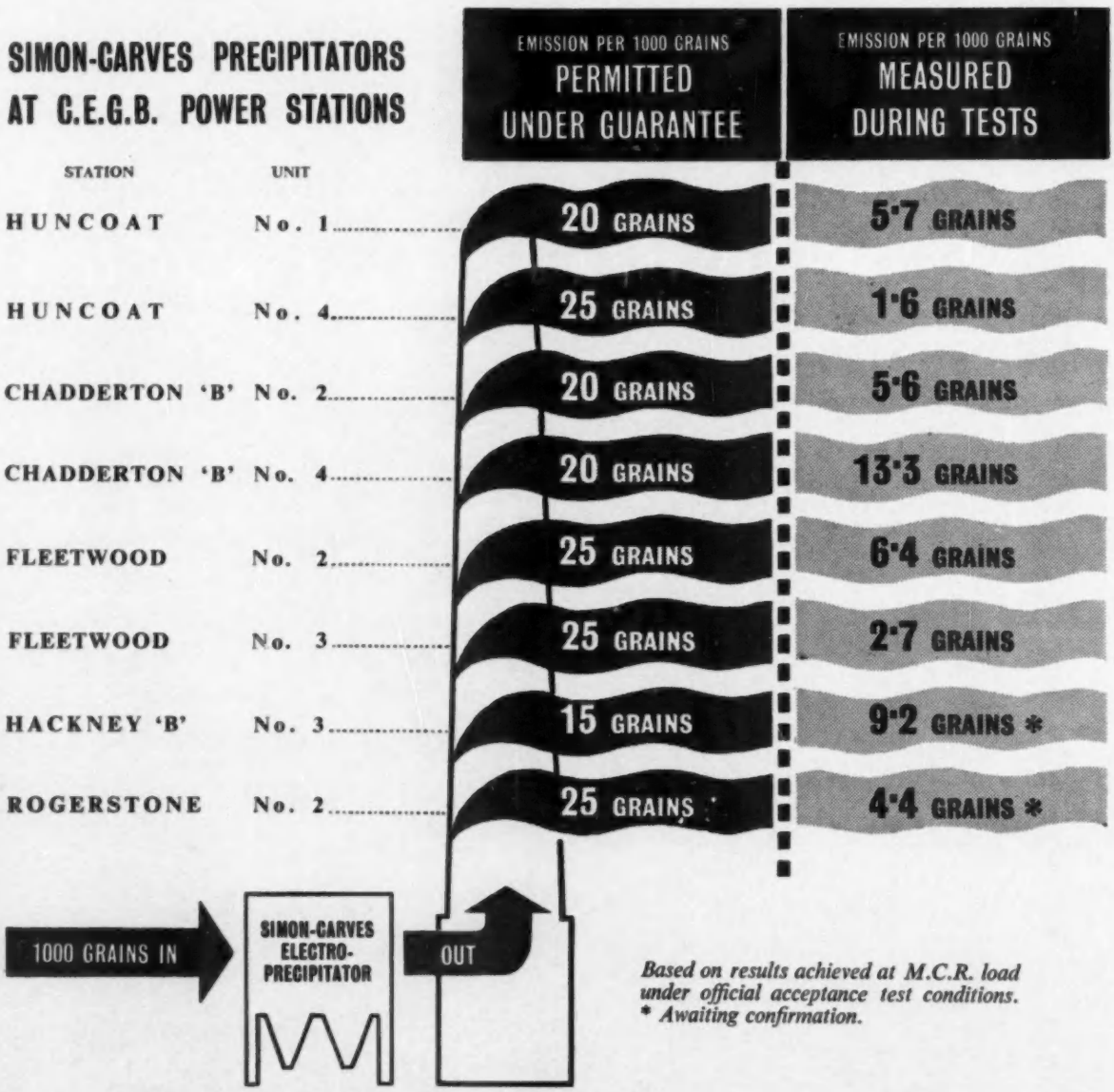
ASSOCIATED COMPANY: ATOMIC POWER CONSTRUCTIONS LTD.

R W G

RICHARDSONS WESTGARTH (HARTLEPOOL) LTD., 58 VICTORIA STREET, LONDON, S.W.1.

PROOF of efficiency

SIMON-CARVES PRECIPITATORS AT C.E.G.B. POWER STATIONS



Based on results achieved at M.C.R. load under official acceptance test conditions.
** Awaiting confirmation.*

HIGH EFFICIENCY ELECTRO-PRECIPITATION BY

Simon-Carves Ltd

SIMON ENGINEERING GROUP

STOCKPORT, ENGLAND

OVERSEAS COMPANIES
SC 199/PS

Simon-Carves (Africa) (Pty) Ltd: Johannesburg

Simon-Carves (Australia) Pty Ltd: Botany, N.S.W.

"What do you mean – *hotter than hot?*"

Peak efficiency in Oil-firing

Even the finest oil fuel, used in the most efficient oil-fired unit will burn more profitably if treated with an *appropriate* additive. FUELSLIP is *appropriate* to oil-fired heating systems, and is one of the SLIP Group of additives—the only products of their kind combining a combustion catalyst in their formulation.

Yet it would be fallacy to imagine that even SLIP additives could vastly improve the performance of oil fuel if used haphazardly. For this reason, SLIP technical service supported by extensive research laboratories is vital to the successful employment of the additives.

Through this service FUELSLIP is supplied, suitably modified for the operating conditions of the installation. Used as advised, complete combustion of fuel is assured, harmful formations and deposits are avoided, resulting in maximum heat efficiency output and the minimum of maintenance.

We shall be pleased to provide you with full descriptive literature and give you the name of your nearest SLIP distributor. There are Slip Agents all over the world ready to advise and serve your overseas interests.

Here's why you need Fuelslip

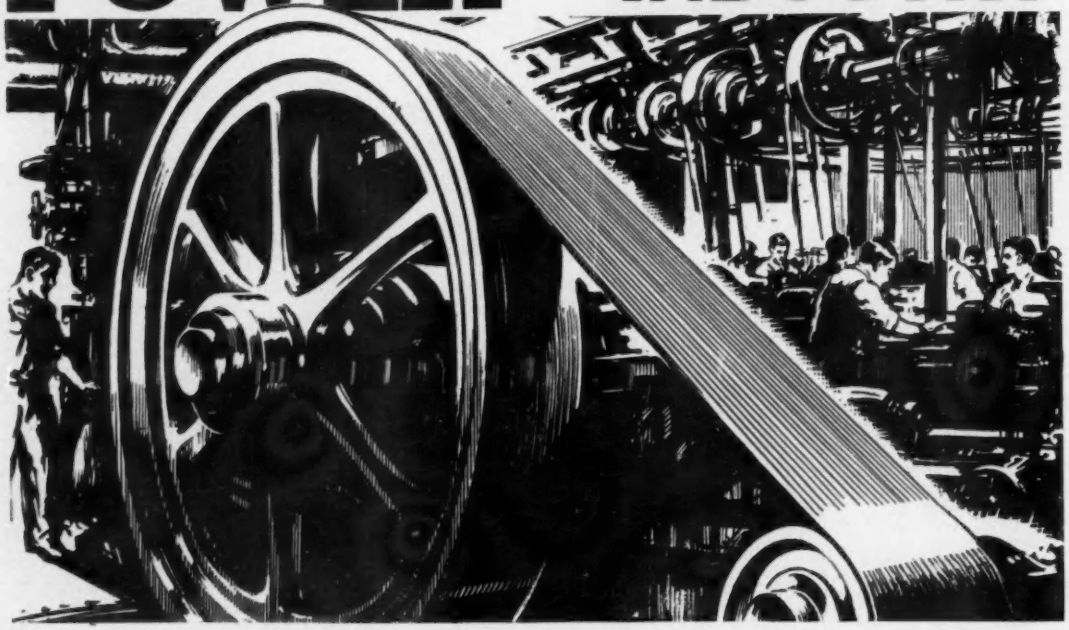
- The combustion catalyst in FUELSLIP enables the by-products of incomplete combustion to be burned *completely* thus avoiding their harmful binding action on carbonaceous matter.
- The restriction of carbon deposits results in better transfer of heat for higher efficiency.
- The detergent action of FUELSLIP keeps the entire fuel system clean and disperses sludge.
- Surface tension reducing agents improve atomisation and thereby increase fuel efficiency.

Fuelslip

THE SLIP GROUP OF COMPANIES. 34 GREAT ST. HELENS, LONDON, E.C.3.

Telephones: AVEnue 1636/8 · TELEX: 23755 LDN CABLES: Slipovaces, London.

POWER for INDUSTRY



For the present, and for many years to come, the principal source of power for machinery, transport, light and heat, will be coal and oil.

The specialised knowledge, vast resources and world-wide organisation of Wm. Cory & Son Ltd. are at the disposal of British Industry for the supply and most effective use of these fuels.

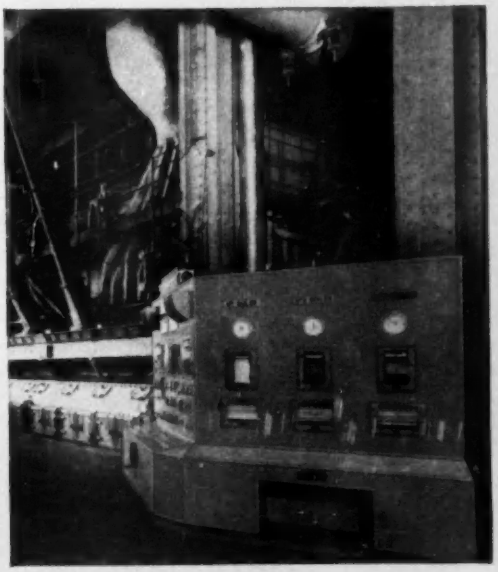
OIL AND COAL
BY ROAD, RAIL & WATER

WM CORY & SON LTD

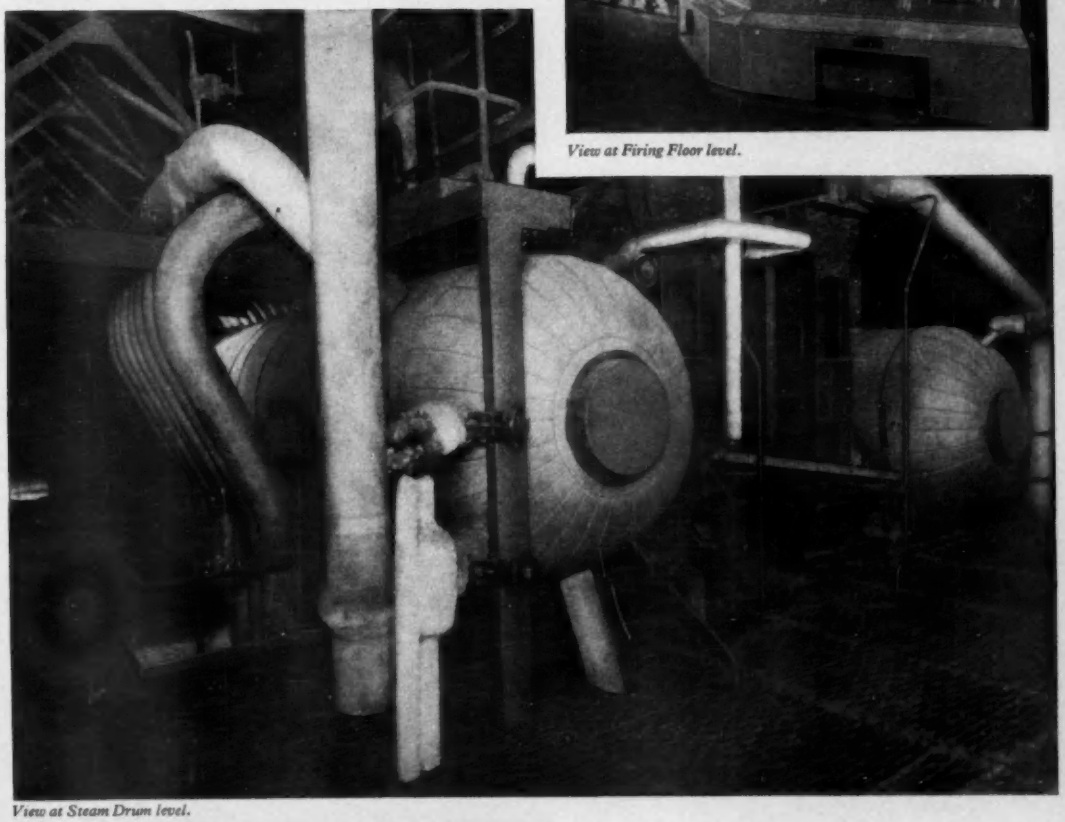
Our Technical Advisory Staff are available for consultation on all problems concerning the most effective use of these fuels, ***and compliance with the Clean Air Act 1956.***

CORY BUILDINGS, FENCHURCH STREET, LONDON, E.C.3. Telephone: ROYal 2500

Six stoker fired Yarrow Boilers recently installed at Dalmarnock Power Station for the South of Scotland Electricity Board. Each boiler is designed for a maximum continuous evaporation of 200,000 lb. per hour at a pressure of 950 lb. per sq. in., and final steam temperature of 925°F.



View at Firing Floor level.



View at Steam Drum level.

BOILERS BY YARROW

YARROW & COMPANY LIMITED · SCOTSTOUN · GLASGOW W4

Have you thought of designing in REFRACTORY CONCRETES?

The idea of "concrete" furnace construction may appear revolutionary, but it has already gained wide acceptance because concrete construction techniques allow the designer and builder to:

THINK IN TERMS OF Monolithic walls, roofs, hearths, etc., NOT brick by brick construction with its joint and other complications.

THINK IN TERMS OF High strengths before, during and after firing.

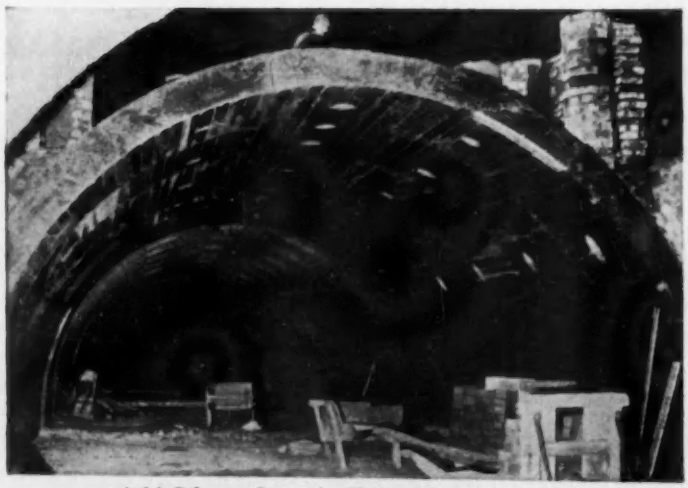
THINK IN TERMS OF Fast construction, smooth walls, easily constructed suspended roofs—all possible by concrete casting.

THINK IN TERMS OF Composite refractory and insulating structures cast in one piece—Refractory Concretes of varying refractoriness and thermal conductivity are easily made.

IN ADDITION

All Refractory Concretes have these points in common:

- **Flexibility of design**
- **Low cost of materials**
- **Low installation costs**
- **Avoidance of delay**



Arch in Refractory Concrete in a Hoffman Kiln of 14 ft 9 in. width.

There is a place for Refractory Concrete in every industry. Practically any shape or size of unit is possible by casting.

If you have an immediate problem write to our Technical Service Section.

CIMENT FONDU Reg. Trade Mark ALUMINOUS CEMENT — up to 1350°C — **CASTABLE REFRACTORY CONCRETES** — up to 1800°C — SECAR 250 REGD. TRADE MARK

WRITE FOR BOOKLETS 'SECAR 250' AND 'REFRACTORY CONCRETE'

LAFARGE ALUMINOUS CEMENT CO. LTD. 73 BROOK STREET, LONDON, W.1. Tel: MAYfair 8546

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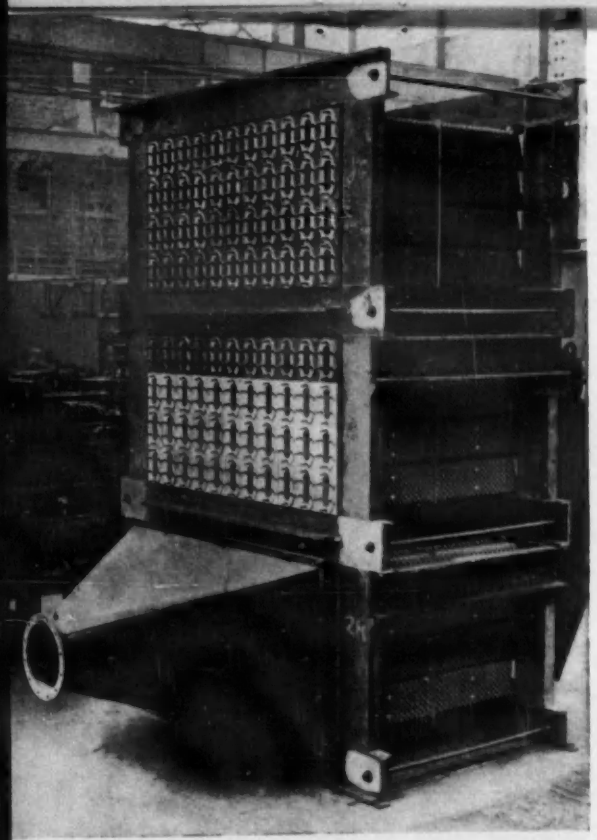

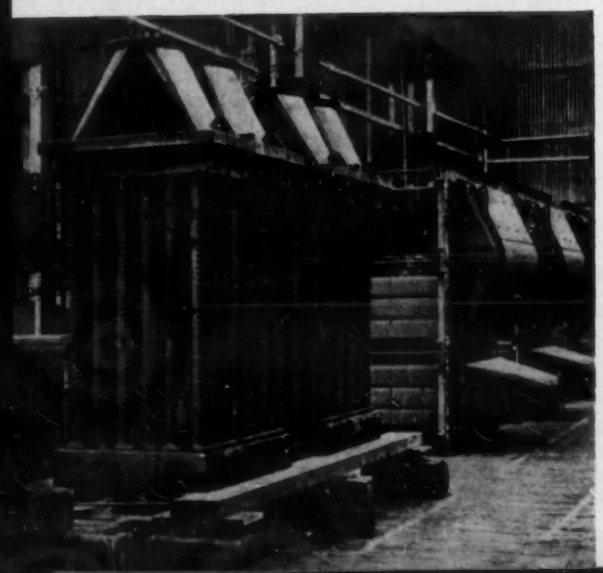

NEWTON CHAMBERS

Heat exchange equipment

FOR MANY YEARS we have specialised in the design, manufacture and installation of heat exchange equipment, particularly recuperators, air heaters and economisers of the metallic needle type. These are made by special moulding methods in heat resisting cast iron and in special alloys including 30% chromium iron.

To extend our range into still higher temperature fields, we have now entered into an Agreement with Industrikemiska Aktiebolaget of Sweden to manufacture and sell the "Inka" radiant type pre-heater which is designed for the super-heating of air, steam and combustible gases, up to 875°C.

We shall be pleased to advise on any heat exchange problem and to quote for the most suitable installations.

LEFT AND ABOVE LEFT: *Newton Needle type recuperators.*

RIGHT: *Inka tube bundle being lowered into position.*

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ENGINEERING DIVISION

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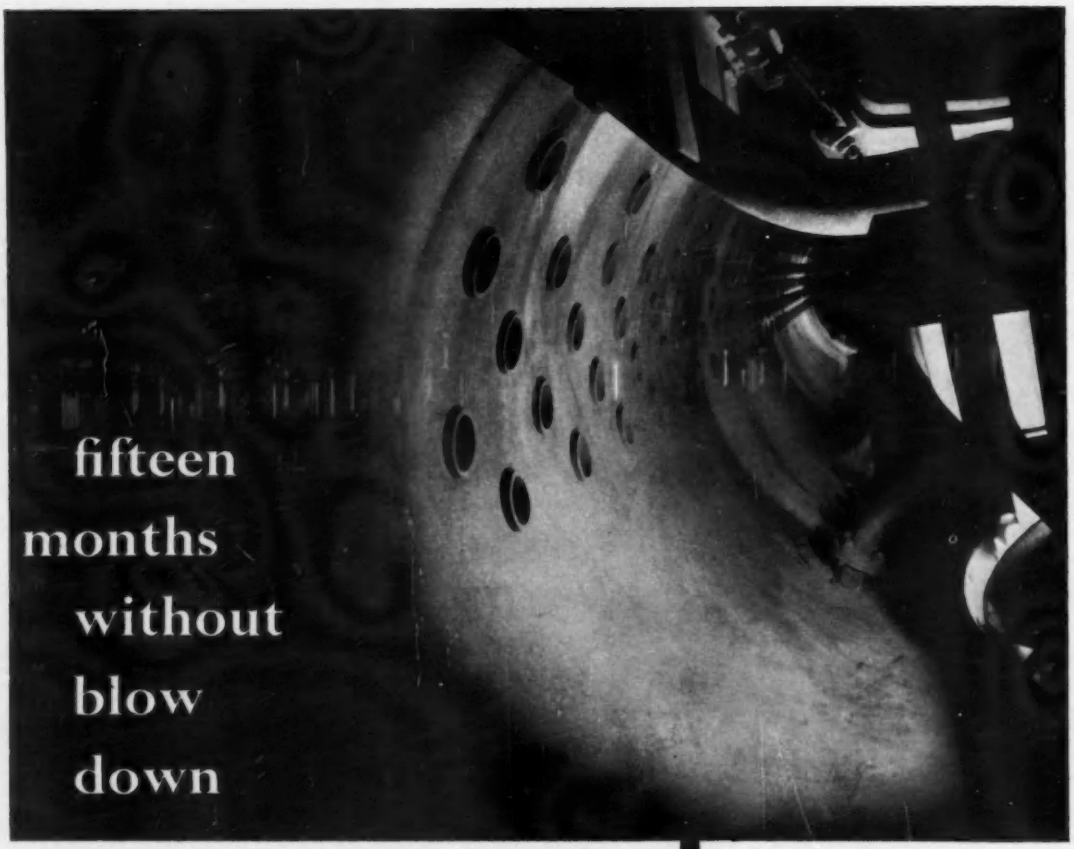

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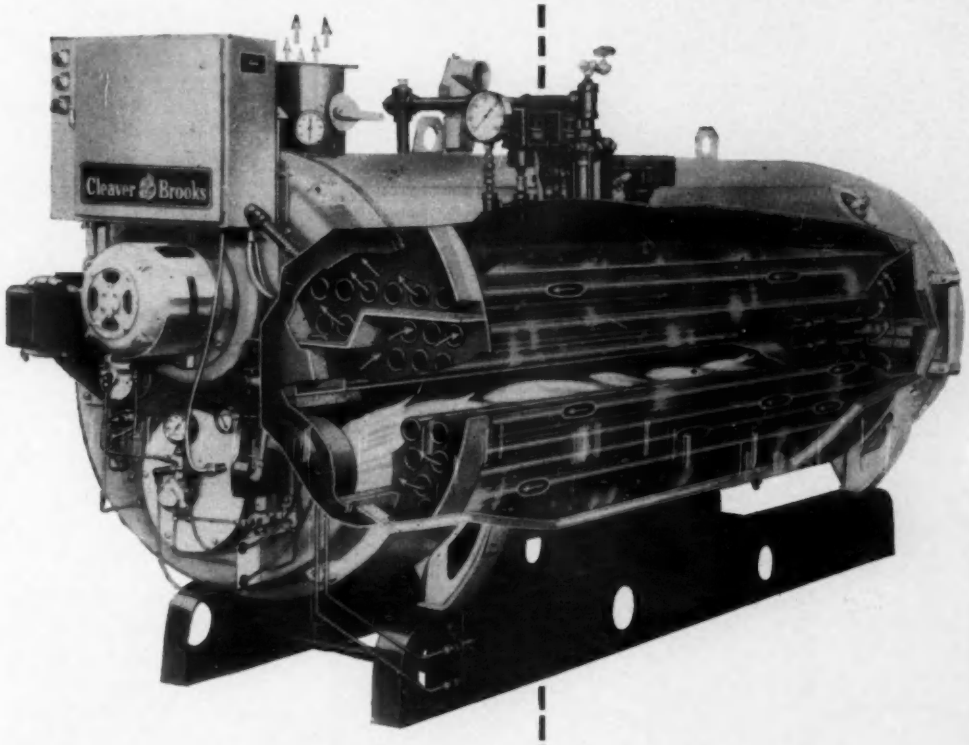

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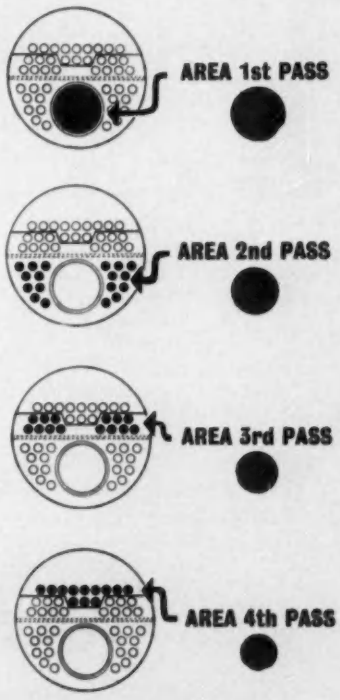

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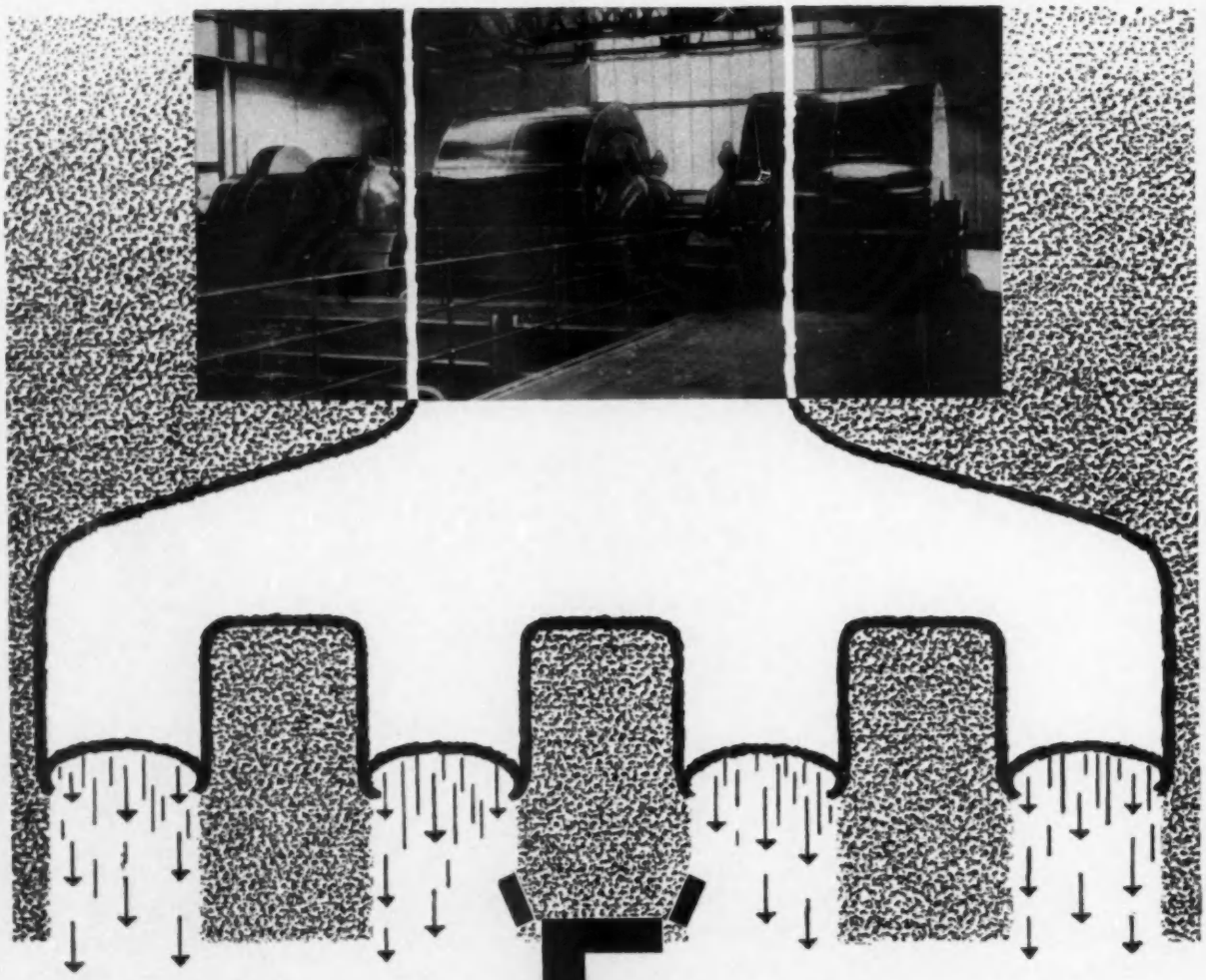

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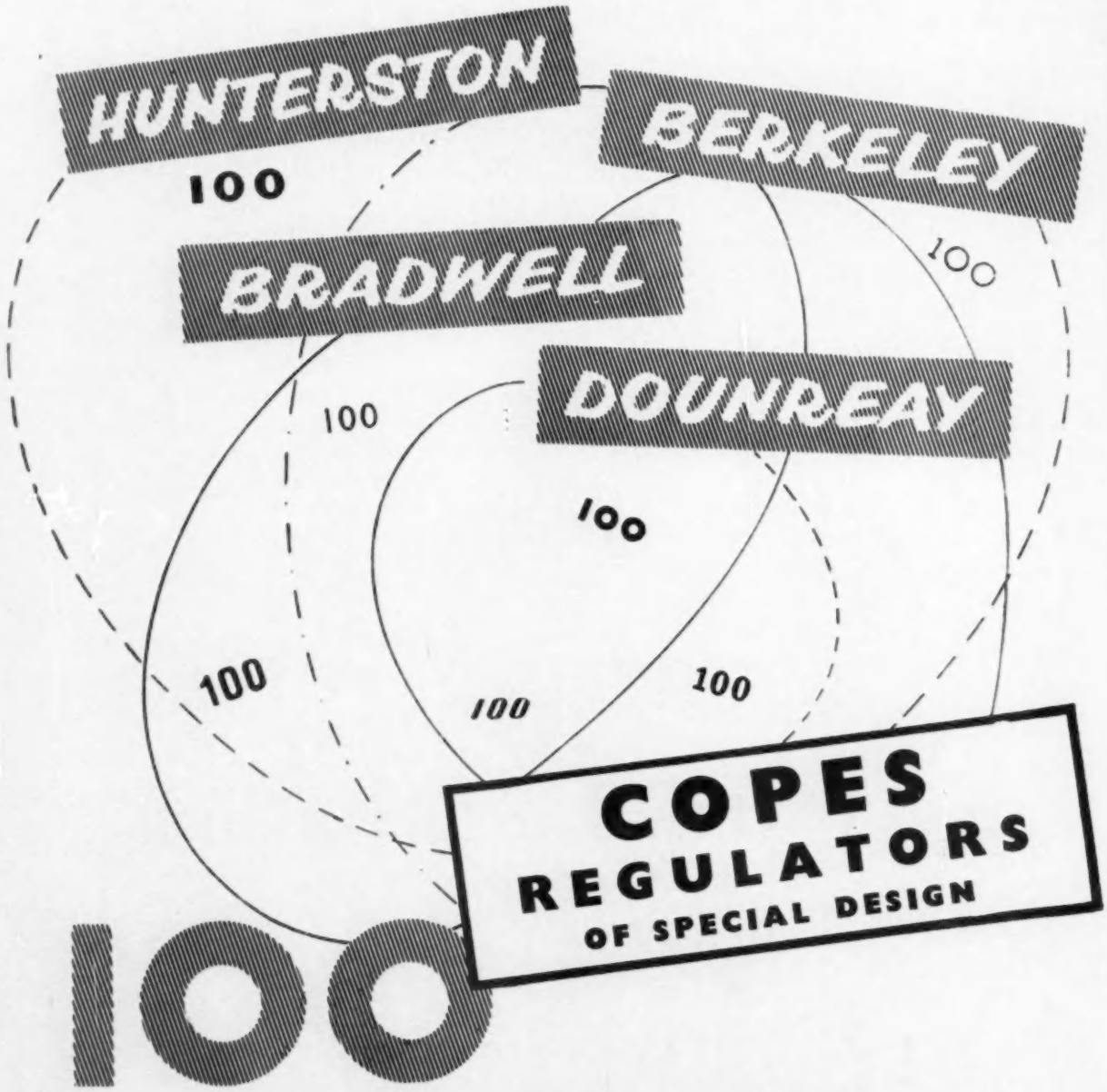

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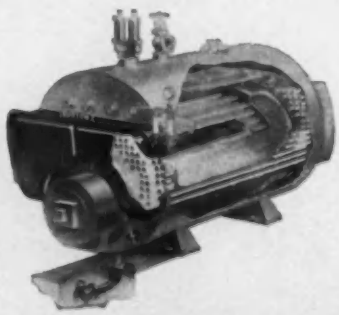

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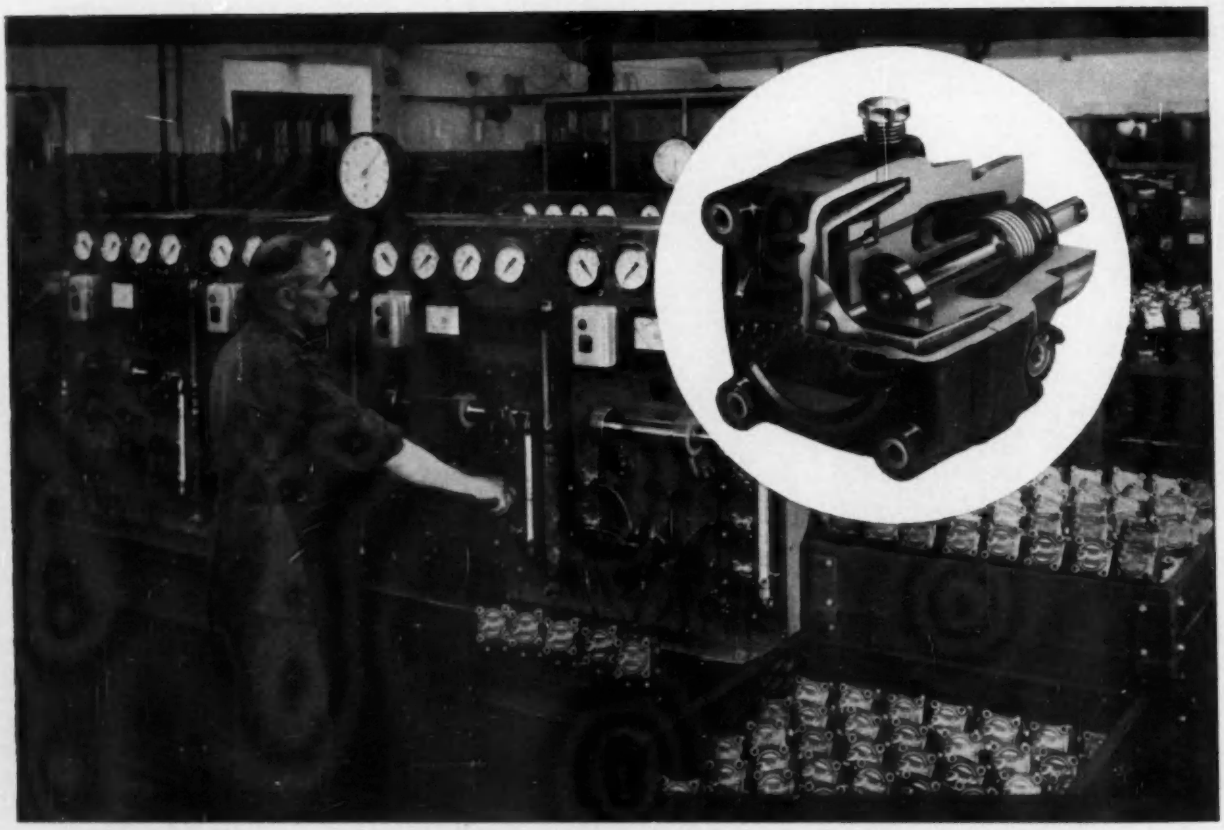

This test-stand guarantees not only the pressure and the suction level as well as the amp consumption and the capacity, but also the cutting off ability of each single HP5 fuel unit leaving the Danfoss works.

This design ensures automatic ventilation of the boiler and instantaneous extinction of the flame. This has the effect that the boiler does not soot up and also that the nozzle does not carbonise.

Primary advantages :

a. a special regulating valve with delayed opening
b. flame is cut off in a flash
c. can be used for both 1 and 2 pipe systems with automatic change over

Further it has following distinctive qualities :

1. small dimensions
2. direction of the circulation can be easily changed
3. large suction capacity
4. noiseless running
5. can be fitted in any position
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Engineering and BOILER HOUSE REVIEW

THE OLDEST ESTABLISHED STEAM ENGINEERING PUBLICATION

OCTOBER 1958

VOLUME 73. No. 10

Principal Contents

	Page
EDITORIAL NOTE	313
POINTS AND POINTERS	314
SOUTH DENES GENERATING STATION	316
A SHORT-CIRCUIT TEST STATION	327
A MODERN FUEL-OIL TERMINAL	328
SILICONE RUBBER SEALS FOR HIGH-TEMPERATURE COUPLINGS	329
INDUSTRIAL FUEL EFFICIENCY EXHIBITION	331
LATEST POWER PLANT PATENTS	343
NOTES—PERSONAL AND INDUSTRIAL	348

The Editor will be glad to receive and consider original contributions, correspondence, etc., of a suitable nature for publication. Stamped and addressed envelopes should be enclosed for the return of any matter considered unsuitable

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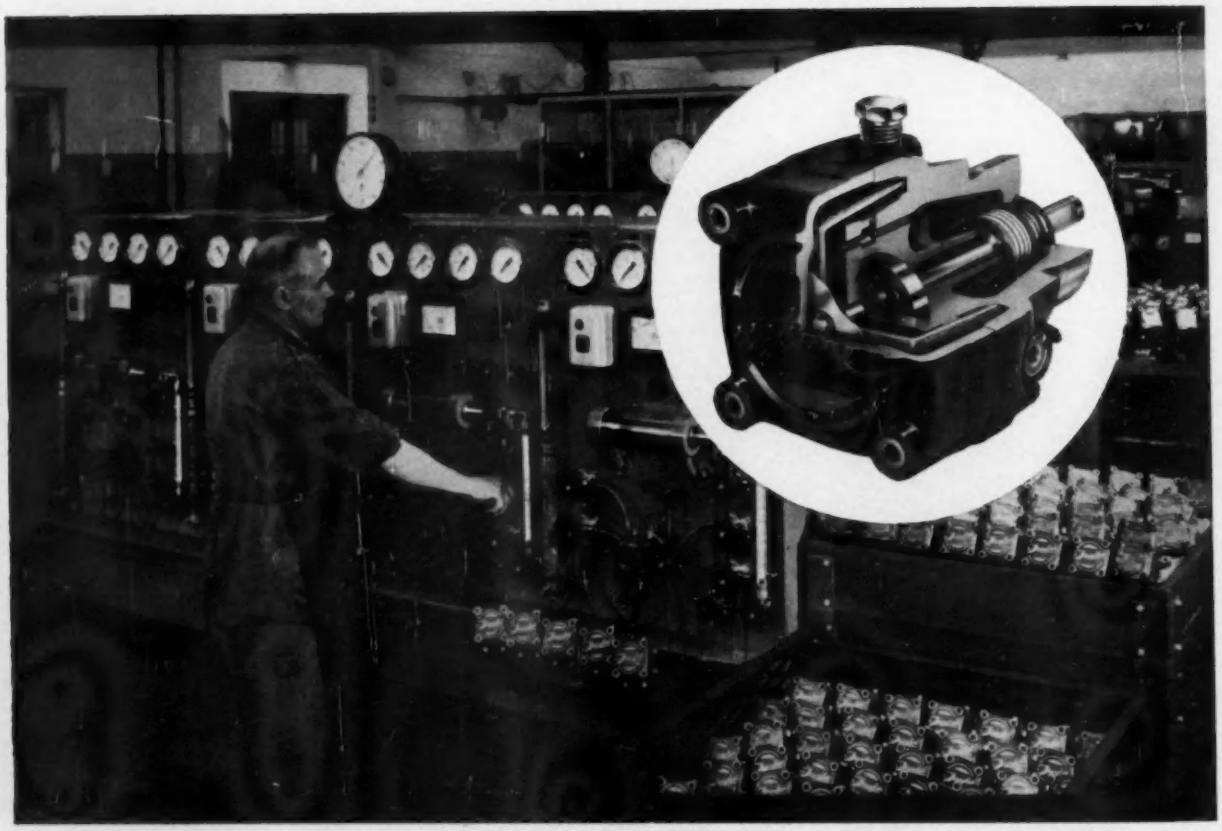

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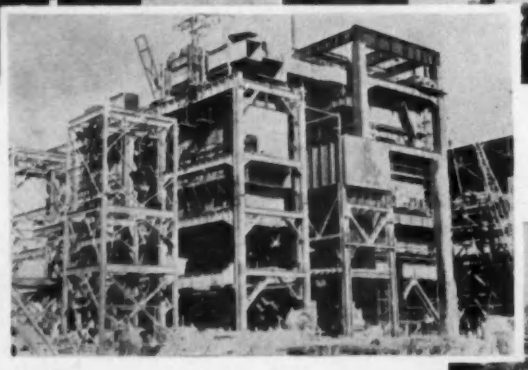
THERMAL POWER *for* NEW ZEALAND



Above and left: Boiler plant during erection at the Mercer power station.

Below: Aerial view of the site on the Waikato river. Fuel will be supplied from the nearby Maramarua coalfield.

In a country where the main source of power is hydro-electric, New Zealand's largest steam power station, now approaching completion near Mercer in the North Island, for the New Zealand Government, is of particular interest.

Being built in one continuous operation, for a capacity of 180 MW, divided between six 30 MW generators, the station is equipped with six Babcock pulverized-fuel-fired Radiant boilers each to supply 300,000 lb./hr. at 635 lb./sq. in., 865°F., in a "semi-outdoor" type installation.

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Engineering and
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OCTOBER 1958

VOLUME 73 No. 10

GENEVA CONFERENCE

THE second United Nations conference on the peaceful uses of atomic energy ended in Geneva on September 12th. In many quarters the conference is being described as being generally successful, in spite of the fact that the event was on such an extensive scale. An enormous amount of material was presented, and, in fact, for most of the time the delegates worked in about half a dozen simultaneous sessions, at which were presented and discussed various papers under the general headings of physics, chemistry, metallurgy, industrial and research applications of radio isotopes, research reactors, power reactors, health and safety, etc.

From the material presented, engineers and scientists all over the world should, and probably will, be able to sort out the precise information they require, and thus give themselves much food for thought. One observer went so far as to suggest that the scientists and science of different nations were on parade in a way which led to some rather disquieting comparisons; and in fact some nations made an exhibition of themselves in the less pleasant aspect of the phrase. The struggle for technical and political prestige was perhaps a little too obvious for a conference of such a scientific character.

It seems that the Russians and the Americans are able to flourish a wealth of scientific effort and achievement somewhat phenomenal in its quantity and variety. There is an almost unrestrained programme under way in each case—clearly reflecting the amount of money being spent, and the size of the organisations spending it.

The British contribution, on the whole, compares very well with all this. Our nuclear power programme is still the largest and most ambitious ; nuclear technology is forging ahead, big business is being done in radioactive isotopes, and applications of atomic energy for surgical or medical purposes are progressing. Zeta is the most advanced of its type of machine yet working in the field of controlled fusion research (although some very promising other types are reported to be the subject of close study in America and Russia). All this is a legitimate cause for satisfaction, and for a mild feeling or glow of patriotism.

But is this country going to maintain the rate of progress in step with other nations ? Despite achievements to date, and a very creditable performance at Geneva, will British atomic science begin to show some signs of strain ? Some people are of the opinion that Harwell not only works, nowadays, in a glare of publicity, but it works at something approaching the limit of the country's capacity. The nuclear energy programme itself represents a huge investment; a comparable investment may, in due course, be needed for the fusion programme. Work on both fission and fusion has been urgently aimed at getting results. Research and development have been limited to a considerable extent to projects which, as far as can be foreseen, offer the best hope of becoming practical propositions in the shortest possible time.

In an evening lecture at the end of the conference, Sir John Cockroft surveyed the work of the conference, and essayed a prediction of what the future holds. He said that the three years since the previous conference have been notable for the coming into operation of the world's first large-scale nuclear power stations—at Calder Hall, Shippingport, and recently Siberia. This has been of great importance, since we have thereby begun to acquire experience on the operating characteristics of such stations, and much new information about their technology is being obtained to supplement the earlier small-scale experiments, in research reactors. The first impressions have been that these nuclear stations have been docile and well behaved. They can generate electricity for months on end until some minor fault develops. The most usual faults have been those with conventional components which require the normal amount of maintenance. There has been a surprisingly small number of defective fuel elements, with failure rates of only three or four per year in 10,000 fuel elements. Reactors using metallic fuel expect to achieve a burn-up of at least 3,000-MW days per ton, so that 1 ton of uranium will do the work of 10,000 tons of coal. Reactors using uranium oxide fuel expect over three times longer burn-up (10,000-MW days per ton), and, indeed, good irradiation stability of small samples has been reported up to 25,000-MW days per ton. Experience of burn-up of full-scale fuel elements is now nearly half-way towards the target. Accelerated experience will be gained in future by increasing the enrichment of the fuel.

The nuclear power stations so far built in the world have been either dual-purpose or demonstration stations, and would not be economic as commercial stations. Nevertheless, the experience of their operation has been invaluable in preparing the way for the next programme, which will mostly concern fully commercial stations with credits for plutonium based on its real value for civil purposes. The capital costs per kilowatt of the first of the commercial nuclear power stations have been very much reduced below those of Calder Hall and Shippingport, but are still more than twice those of coal- or oil-fired stations. The capital cost of U.K. nuclear power stations will fall a further 20 per cent. by 1962 as the output goes up from 300-MW to 500-MW, and a further fall of at least 10 per cent. by straightforward engineering developments and increase of output is forecast. The boiling water reactor power stations seem to be growing in favour as a result of the good performance of experiments. Because of their low system pressure and small size and comparative simplicity, they may achieve very low capital costs in the next five years.

Points and Pointers

COAL SCIENCE LECTURE Sir Charles Goodeve, O.B.E., D.Sc., F.R.S., has accepted an invitation from the Council of The British Coal Utilisation Research Association, to deliver the B.C.U.R.A. 7th Coal Science Lecture at the Institution of Civil Engineers at 5.30 p.m. on October 15th. For his subject he has chosen "Carbon :—The Key to Metallurgy." Sir Charles is Director of the British Iron and Steel Research Association, a position he has held since its formation in 1945. From 1927 to 1939 Sir Charles worked at University College, London, where he became Lecturer in Physical Chemistry in 1930 and Reader in Chemistry in 1937 ; his principal researches during this period were in physical chemistry, particularly photochemistry, absorption spectra and reaction kinetics. From 1939 to 1945 he served the Admiralty as a Deputy Controller, and his researches materially helped to overcome the enemy at sea. For services in this connection he received a Knighthood in 1946 ; he was also awarded the United States Government's Medal of Freedom with Silver Palm. As a member of the Council of the Faraday Society, Sir Charles participated in the 1948 Conference on "Physical Chemistry of Process Metallurgy," and from 1950 to 1952 he held the office of president of the society. He is a vice-president of the Parliamentary and Scientific Committee and, from 1953 to 1956, he was a member of the Advisory Council on Scientific Policy to the Lord President. He is a member of the Technical Advisory Panel of the Iron and Steel Board. Vice-president of the Iron and Steel Institute, and Master of the Salters Company. He was appointed president of the Chemistry Section (1956) of the British Association for the Advancement of Science and, at the inauguration of its 1956 meeting, the honorary D.Sc. of the University of Sheffield was conferred upon him.

CONFERENCE OF COMMONWEALTH SCIENTISTS The Conference of Commonwealth Scientists opened at Harwell on September 15th when representatives of nine Commonwealth countries were welcomed by Sir Edwin Plowden, chairman of the United Kingdom Atomic Energy Authority, Sir John Cockcroft, member of the Authority for Research, Mr. W. Strath, member for External Relations and Commercial Policy, and Mr. J. C. C. Stewart, deputy managing director of the Industrial Group, who was representing Sir William Cook, member of the Authority for Engineering and Production. At the inaugural session there was an opening address by Sir Edwin Plowden, who said that since the early days of military work at Chalk River they had been accustomed to work together, and in addition to organised co-operation there was the work of individuals. The United Kingdom Atomic Energy Authority owed much to individual members of their staff born or educated in other Commonwealth countries. Britain was always ready to put her experience at the disposal of her Commonwealth friends and he knew that other Commonwealth countries which had experience in atomic energy were equally ready to share it. There was work for all and benefit for all in this fascinating field of nuclear science and technology. The difficulties were often formidable and the effort required to surmount them very great. But the prizes were great also, and our success so far gave confidence that they were attainable. To win them was a venture in which all of them could be proud to participate. Sir John Cockcroft outlined atomic energy research and development in the United Kingdom ; Mr. Stewart read a paper by Sir William Cook on "Engineering and Production in the Atomic Energy Authority," and Dr. B. F. J. Schonland, director of the Atomic Energy Research Establishment, gave a review of its work. During the afternoon the delegates visited various parts of the Atomic Energy Research Establishment, and after continuing the conference at Harwell, later in the week visited other establishments of the Authority, including the experimental establishment at Dounreay, Caithness.

EXPANSION OF TECHNICAL EDUCATION A call to industry for full-scale support for Government plans to expand and improve the British system of technical education was made on September 16th by Mr. Geoffrey Lloyd, Minister of Education. A new pamphlet, "Britain's Future and Technical Education," published at the same time has the full support of national industrial organisations including the F.B.I. and T.U.C., the British Employers' Confederation and the Association of British Chambers of Commerce, who are distributing it to their members throughout the country. The pamphlet describes the pattern being followed in the development of technical colleges in England and Wales, and shows how industry and commerce can play their part in the nation-wide scheme. In a foreword, Mr. Geoffrey Lloyd says that with the vigorous co-operation of local education authorities the £100 million technical education expansion programme is making rapid progress. Great efforts are also being made to expand the universities, and to improve and extend secondary education. "But the development programme for the technical colleges does not depend only on the efforts of the Government and local authorities," says the Minister. "It needs the full backing and support of industry and commerce. Without this help, we cannot be sure of having courses of the right type, or students to put in them, or teachers to man them. I know that it costs employers time and money to give this support. Nevertheless this effort must be made if this country is to have the skilled men it needs." The £100 million programme is moving ahead fast. Since the White Paper was published in 1956, the whole building programme for England and Wales of £70 million has been approved, £27 million of this has been started and £16 million completed.

The final success of the plan must, however, depend on the co-operation and support of industry. The Government's five-year plan aims at increasing the output of advanced-level students—destined for the professions and higher technical posts—from the 1955 figure of 9,500 to about 15,000. Most of these students now come from part-time courses ; about half of them gain professional qualifications and the remainder become high-grade technicians. As the structure of industry and commerce becomes daily more and more complex, and the various technologies develop, the part-time course can no longer be relied upon to produce enough of the highly qualified men and women needed. The Government's intention is that the bulk of the extra output shall come from full-time and "sandwich" courses. The sandwich course, says the pamphlet, "is probably the key to a really big expansion of technical education at the advanced level." Sandwich courses, lasting from three to five years according to the type of course followed, entail six months' study in college and six months in industry, pursued alternately. The course, unlike part-time study, gives time for a broad and comprehensive education allied to solid industrial experience. Many types of sandwich course now exist, including those leading to high academic qualifications such as the new Diploma in Technology, to be awarded by the recently-founded National Council for Technological Awards. The Dip. Tech. is equivalent to a university honours degree. The placing of students in the type of course which suits them best will, therefore, be extremely important, and will call for the closest possible co-operation between the technical college and the employer.

BRITISH PLANT FOR ITALIAN NUCLEAR POWER STATION

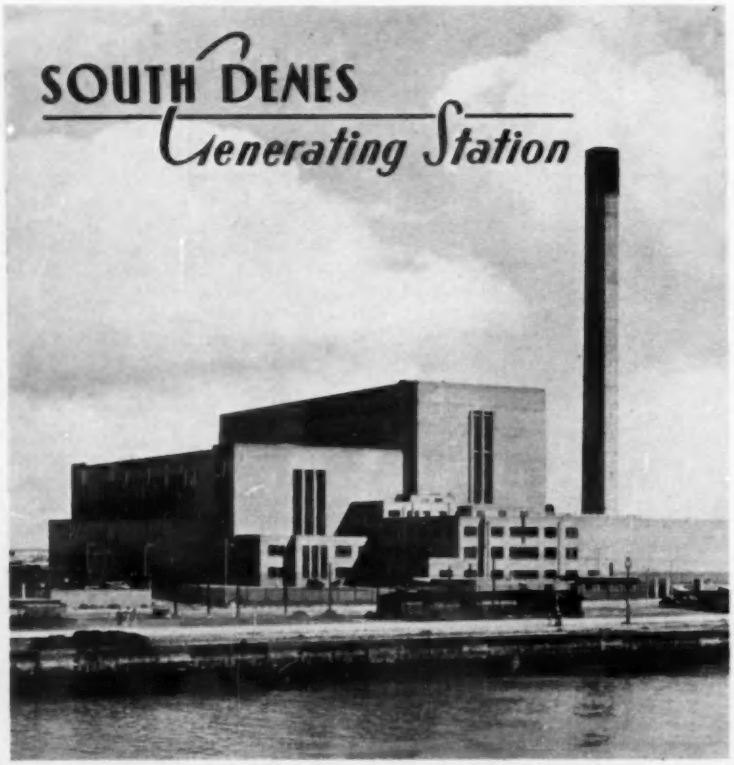
In the June issue of this journal, we made extensive reference to the signing of a long term agreement for collaboration between the Nuclear Power Plant Company Limited, Knutsford, Cheshire, and AGIP Nucleare of Milan, in the construction of nuclear power stations in Italy over a minimum period of seven years. This agreement, which covers the exchange of information on the design, construction and operation of nuclear power stations, the training of technical staff, and collaboration in research, was signed by Sir Claude Gibb, chairman of The Nuclear Power Plant Company Limited, and Signor Mattei, president of E.N.I. on behalf of Agip Nucleare of Milan. The logical development of the agreement is the recent signing of the formal contract for the construction of a 200-MW nuclear power station to be built near Latina, some 40 miles south of Rome. The value of the contract to British industry is stated to be in excess of £10 million, and the member companies of the Nuclear Power Plant Company will supply the reactor, the turbo-alternators, blower units and other associated equipment. A similar amount of money will be spent in Italy for civil works, conventional machinery and erection of plant. The United Kingdom Atomic Energy Authority will guarantee the supply of fuel for the life of the station. Work in the United Kingdom has already started, and the station will be commissioned fully by mid-1962. The contract agreement was signed in Lausanne, Switzerland, a week or so ago by Ing. G. Martinoli, president of the Societa Italiana Meridionale Energia Atomica, and Mr. A. J. Sayers, director and general manager of the Nuclear Power Plant Company Limited.

INCORPORATED PLANT ENGINEERS

The education committee of Incorporated Plant Engineers announce that the next of their comprehensive refresher courses for senior works and plant engineers is to be held this winter at Liverpool University. This is the latest of a series of major courses at various centres in Britain, all of which have set up enrolment records for engineering refresher courses. It will comprise eighteen weekly lectures on Thursday evenings, and is to be opened on October 30th by Sir Oliver Lyle, O.B.E., F.Inst.F., Hon. M.I.Plant E., joint managing director of Tate & Lyle Ltd., who has taken a prominent part in these refresher courses since their inception. The syllabus covers :—The Planning and Control of Maintenance, Cost Consciousness and the Engineer, The Application of New Materials to Plant Engineering, Properties and Treatment of Metals and Alloys, Developments in Welding Practice, Lubrication, Combustion, Oil Firing, Steam Utilisation, Thermal Insulation of Industrial Buildings, Current Techniques and Future Trends in the Planning of Plants and the Operation of Processes, Materials Handling, Industrial Accident Prevention, Communications and Human Relations, and The Impact of Automation on the Plant Engineer. Designed to encourage the most effective use of existing knowledge, and to promote the application of up-to-date techniques in works engineering practice over a broad field, its purpose is to help works and plant engineers to make the fullest possible contribution to increasing productivity. The fee for the course is four guineas and copies of the syllabus and full particulars may be obtained from the Secretary to the Refresher Course at The Donnan Laboratory, Vine Street, Liverpool 3.

IRON AND STEEL

We note from a statement by the Iron and Steel Board that pig-iron production in August averaged 221,000 tons per week, compared with 272,500 tons per week in August last year. It is also stated that steel output averaged 299,200 tons per week compared with 373,400 tons in August, 1957. It appears that steel production in August was especially low in the north-east-coast area and in Scotland where, according to the Board, the extended holiday period was taken as a result of the fall in the demand for plate and other heavy rolled products. At present, steel consumption is estimated to be approximately 5 per cent. below last year's level ; the much greater fall in production is attributed to the reduction in stocks and in exports. The statement points out that for the first time since the end of 1954, stocks of finished iron held by consumers fell during the second quarter of 1958, while the stocks held by merchants increased slightly. After allowing for the fall in stocks, it is estimated that steel consumption during the second quarter of the year was only slightly below that in the comparable quarter of last year. Nevertheless, it was appreciably below the level reached in the second half of 1957. The Board says that the decline appears to have continued in the last two months.



SOUTH DENES GENERATING STATION, GREAT YARMOUTH, WAS FORMALLY OPENED ON SEPTEMBER 26th BY COL. SIR EDMUND BACON, Bt., O.B.E., J.P., T.D., H.M. LIEUTENANT OF NORFOLK. WHEN COMPLETED, THE STATION WILL HAVE AN INSTALLED GENERATING CAPACITY OF 240-MW

AS far back as 1939 the construction of a new power station at a site on the South Denes at Great Yarmouth was being investigated, and negotiations for the purchase of land had commenced. The war interrupted this planning, and it was not until 1946 that the Great Yarmouth Corporation were asked to consider the installation of additional plant in the existing station, and the possibility of providing a new station was reconsidered. At that time, the installed generating plant in the Corporation Power Station totalled 15.25-MW, and it was steamed by boilers having a total evaporative capacity of 230,000 lb./hr. Steam conditions were 265 lb./sq. in. and 750 deg. F. During the year preceding nationalisation (1947) units generated totalled 50.66 million—the total units sent out being 48.67 million. Following nationalisation in April, 1948, the (then) British Electricity Authority (Eastern Division) assumed responsibility for the project for the new station. Thus the architectural treatment, and the design and construction of the station, has, throughout, been under the direction of Mr. W. N. C. Clinch, M.I.E.E., F.Inst.F., the divisional controller. Messrs. Rendel, Palmer and Tritton were retained as consultants for the foundations, river and sea works. The consent of the Minister of Power to the new station, with an installation of 240-MW of generating plant, was given in July, 1953, and construction began in May of the following year. The first of the four 60-MW units which the station will eventually contain was commissioned in September, 1957, and the second unit was brought into service in March, 1958. Construction is still proceeding and it is planned to bring the third unit into service in May, 1959, and the final unit in January, 1960. Electricity from the generating units at present in service is supplied to the 33-kV distribution system, whilst that from the third and fourth units will be supplied direct to the 132-kV national grid system.

Building and civil engineering works

The sub-soil over the station site consists of consolidated sand to a considerable depth. Foundations were formed by excavating the sand as required and placing a reinforced-concrete raft 2-ft. 6-in. thick over the station area. This raft is below the standing water-level, and so that work could proceed, the water-level was lowered by the well-point system of de-watering. All the buildings, including the offices and workshops, are of steel-framed construction clad with sand-faced bricks in two shades of colour. The roofing of the turbine and boiler houses is of light steel sheeting covered with insulating and waterproofing materials. The boiler house roof is 130-ft., and the turbine house roof 83-ft. above basement level. The chimney, which was built by Bierrum & Partners Ltd., is 360-ft. high and is constructed in reinforced-concrete, which is coloured to blend with the station brickwork. The load from the chimney is supported by concrete foundations spreading to 57-ft. square at a depth of 25-ft. below the surface. The civil engineering work includes a reinforced-concrete quay 1,400-ft. long supported on reinforced-concrete piles, and on which facilities are provided for discharging oil-tankers. The circulating-water intake works incorporated in the quay are the tunnels for circulating water, constructed from the quay to the

station. The discharge from the condensers is taken through culverts to the North Sea, with the outfall head at a distance of 680-ft. from the sea wall.

The station was originally designed for coal firing but, in 1955, it was decided to convert to oil firing, using residual oil with a viscosity of 6,000 sec. Redwood No. 1. Although the coal-handling plant pulverising equipment and ash-handling plant was not installed, provision has been made in the design for such plant, should it be found desirable to reconvert the station at some future date. The coal bunkers have, however, been installed in the boiler house, along the south side.

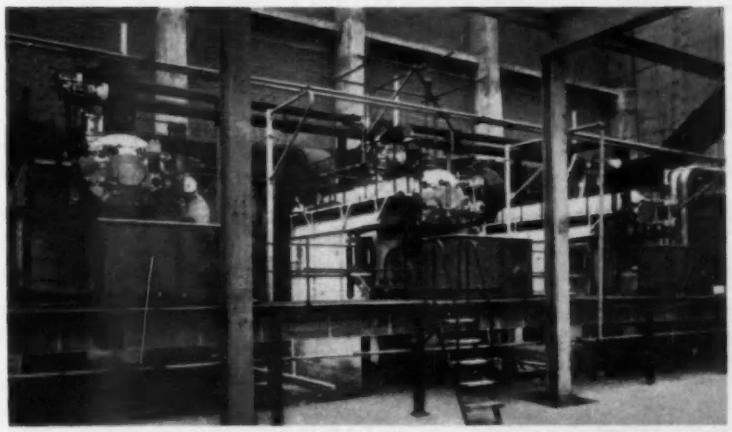
Oil fuel handling plant

Oil fuel delivered at the quay by ocean-going tankers is pumped to storage tanks, three of which will ultimately be installed, and which will give a total storage capacity of 38,500-tons. Transfer pumps deliver the oil to the station, and heating and pumping plant in the boiler house deliver the oil to the boiler burners at a pressure of 600 lb./sq. in. and a temperature of 280 deg. F. Hot water is used for heating the oil to the requisite final temperature and for maintaining the storage tanks and pipelines at a temperature which will enable the oil to be circulated. This water is provided at a pressure of 250 lb./sq. in. and at a temperature of 400 deg. F. by three automatically-operated auxiliary boilers, placed in the station yard adjacent to the chimney. These boilers were supplied by Davey, Paxman & Co. Ltd. and are of that firm's type 300 K. They are designed for working pressure of 310 lb./sq. in. although the present operational pressure is 250 lb./sq. in. Each unit has an evaporative capacity of 9.7 million B.Th.U./hr. There are two 34-in. dia. water drums on each boiler, and they are connected by 394 water tubes each 2-in. dia. The boilers are completely packaged units—and are provided with pressure-jet oil-burners, I.D. fans and necessary ducting, water-level indicators and flame-failure detection equipment. These boilers are fired with oil of 6,000 secs. Redwood No. 1 at a temperature of 100 deg. F. All three units are completely lagged and provided with the necessary protection for outdoor operation.

Boiler plant

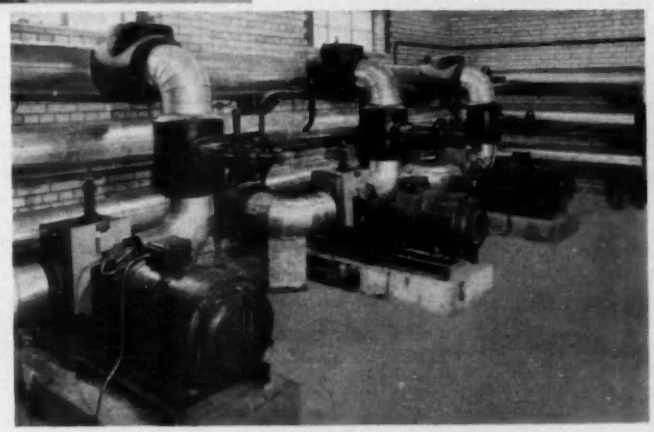
Each of the four main boilers which the station will contain is arranged to be connected as a unit to one turbine, to which it provides steam at a pressure of 900 lb./sq. in. and a temperature of 900 deg. F. The two units (Nos. 1 & 2) now in service were supplied by International Combustion Ltd. Each is provided with 28 oil-burners, with seven burners in each corner of the combustion chamber. Automatic steam temperature control is obtained by tilting the burners and by spray-type de-superheaters. Each of the two boilers (Nos. 3 & 4) now being constructed and installed by Mitchell Engineering Ltd., will have 12 oil-burners located in the front wall of the combustion chamber with automatic steam temperature control obtained by spray-type desuperheaters only.

The two International Combustion boilers have an evaporative capacity of 550,000 lb./hr., at m.c.r., with steam conditions 950 lb./sq. in., and 910 deg. F. The boilers were originally designed for pulverised-fuel firing and were converted to 100 per cent. oil-fuel firing during the early stages of construction. They are of the Radiant type with fully water-cooled finned-tube combustion chambers arranged for corner firing. Combustion gases leave the furnace through an exit channel containing the pendant secondary superheater, thence through a small amount of boiler convection surface and vertically downwards through the primary superheater and the economiser. The primary superheater is of the horizontal element drainable type arranged in two banks. After



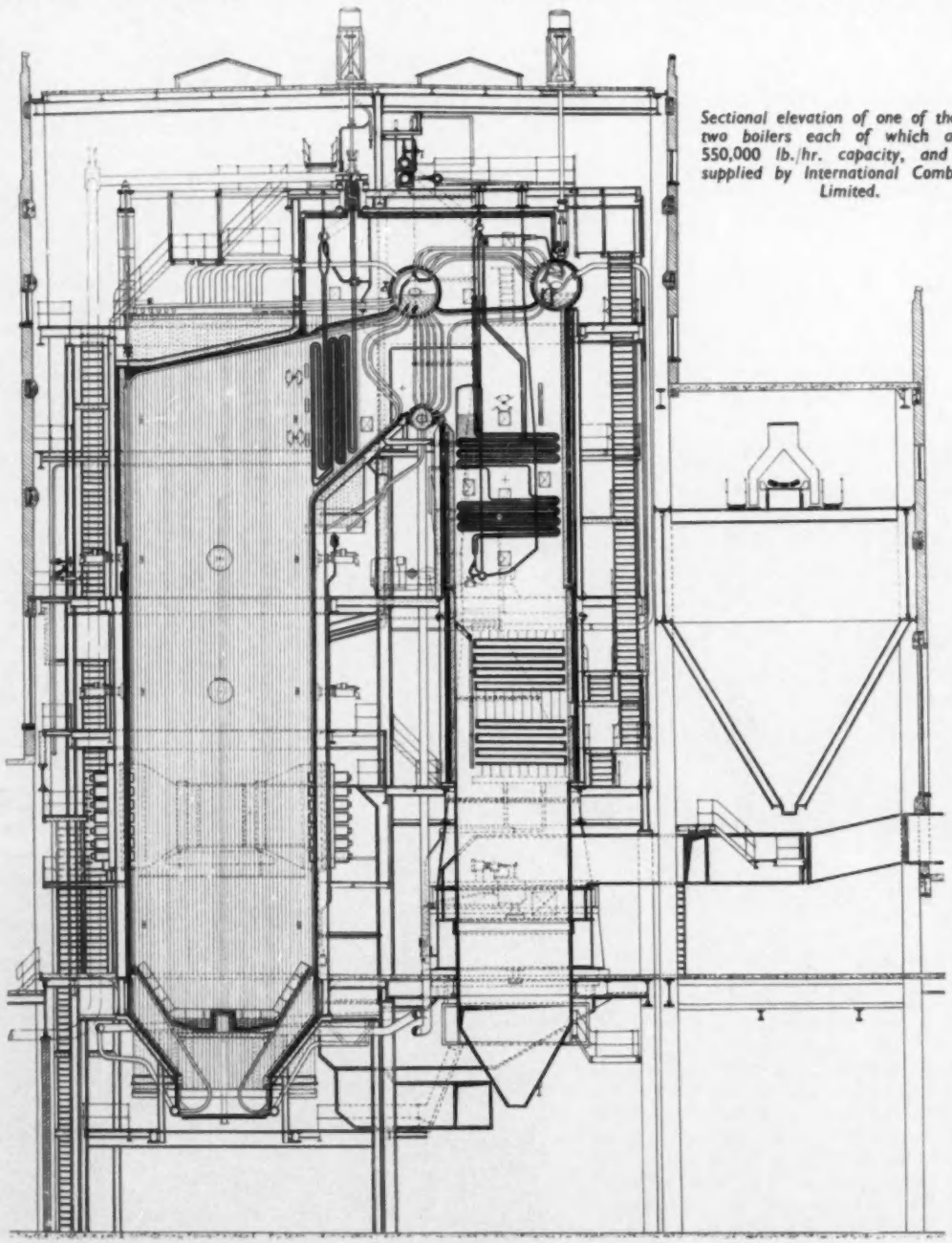
(Left). The three auxiliary hot water boilers for the tracing of fuel-oil pipe-lines were supplied by Davey, Paxman & Co. Ltd.

(Below). Oil fuel transfer pumps which deliver the oil from the storage tanks to the oil heating and pumping plant.



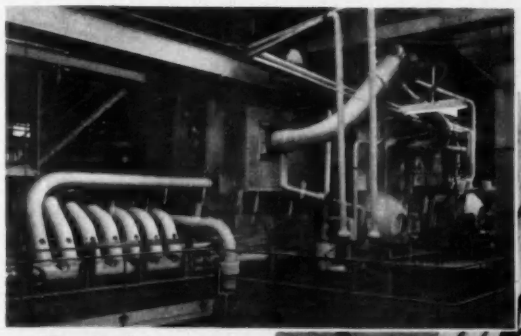
the economiser, the gas flow divides into two parallel and identical streams, each containing a regenerative air-heater, mechanical dust-collector and induced-draught fan. Combustion air is supplied by two F.D. fans via the air heaters. Superheat temperature control is provided by the tilting burners already mentioned together with spray desuperheating. The boilers are provided with on-load cleaning arrangements in the form of gun-type and lance-type sootblowers which are electrically-operated and remotely sequence controlled from the control room.

The superheaters are of the " MeLeSco " type supplied by The Superheater Co. Ltd., and consist of primary and secondary sections with interposed spray-type desuperheaters. The primary superheater consists of 80 elements installed at a transverse pitch of 4-in. arranged in two horizontal banks in the rear pass of the boiler. The secondary superheater is located at the furnace outlet and consists of 44 elements arranged in one pendent section. The total heating surface is 22,720 sq. ft. and it is of interest to note that the original

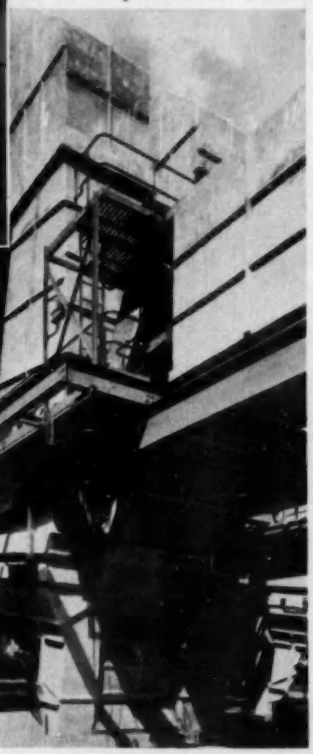


Sectional elevation of one of the first two boilers each of which are of 550,000 lb./hr. capacity, and were supplied by International Combustion Limited.

superheater proposed was for operation under coal firing, and, therefore, it was necessary to modify this superheater to suit the change-over to oil fuel. The primary elements are supported by means of heat-resisting steel blocks welded to hanger tubes and the secondary elements are suspended directly from the headers. Spacing of the primary elements across the boilers is maintained by use of heat-resisting steel spacer castings. The steam temperature at the superheater outlet is automatically regulated over the range of boiler loads of 80 per cent. c.m.r. to c.m.r. by means of the tilting burners supplemented by the two manually-operated interstage spray-type desuperheaters.



(Right). View at drum level of No 1 boiler.



(Below, right). Outlet flue ducting and I.D. fans for No. 1 boiler.

Each boiler is provided with two Howden Ljungstrom rotary type air-heaters, each of 54,100 sq. ft. heating surface, and designed to reduce the flue gas temperature from 543 deg. F. to 309 deg. F. while preheating the combustion air from 80 deg. F. to 500 deg. F. These air-heaters are of the type normally supplied for oil-fired boilers, the elements being arranged in two tiers and fitted into removable containers. Sector doors are fitted in the pre-heater housing to permit access to the elements without entering the ducting, the lower sector door being fitted with a hydraulically-operated hoisting device. A washing chamber and sludge trough are fitted to the underside of the preheater so that the elements may be washed without removal if required. There are two forced-draught, two induced-draught and two secondary-air fans provided for each boiler; all these fans being supplied by James Howden & Co. Ltd. The duty of each F.D. fan is 90,600 cu. ft./min. at 80 deg. F., of each I.D. fan 146,000 cu. ft./min. at 266 deg. F., and of each secondary air fan 22,300 cu. ft./min. at 280 deg. F. The vane-controlled F.D. fans, which are located half-way up the boiler are each driven at a speed of 970 r.p.m. by a 206 h.p. squirrel-cage motor supplied by Laurence, Scott & Electromotors Ltd. The I.D. fans which are at basement level, are driven by Laurence Scott S.C. motors of 405 h.p., through size 32 scoop-control fluid couplings, type SCR.4, supplied by Fluidrive Engineering Co. Ltd. These fluid couplings allow for an infinitely variable speed regulation from 965-200 r.p.m. On the Mitchell boilers (units 3 & 4); the Howden I.D. fans will each be of 136,000 cu. ft./min. capacity at 275 deg. F. They will be driven by 320 h.p. 970 r.p.m. motors supplied by The General Electric Co. Ltd., through size 29 scoop-control fluid couplings, to give a speed regulation from 940-200 r.p.m. The F.D. fans will be of 106,000 cu. ft./min. capacity and driven by G.E.C. 256 h.p., 980 r.p.m. motors.

The dust extraction equipment comprises two multi-cellular mechanical units of the cyclonic type, per boiler. Dust is drawn from the boiler hoppers by an exhauster type dust-handling plant supplied by British Vacuum Cleaner Ltd. This plant is also equipped to carry out general station cleaning.

A "Senior" welded cast-iron clad economiser, supplied by Senior Economisers Ltd., is installed with each of the four boilers. The economisers installed with the International Combustion boilers (Nos. 1 & 2) each have a heating surface of 69,000 sq. ft. and are arranged 20 tubes wide, by 30 high in two nests. Gas inlet and outlet temperatures on m.c.r. load are 1,155 deg. F. and 548 deg. F. respectively. The water temperature is raised from 385 to 551 deg. F. A partial gas by-pass is arranged integral with the economiser to raise the gas temperature at the air-heater inlet when necessary. Similar Senior economisers are installed with the Mitchell boilers (Nos. 3 & 4) but they each have a heating surface of 59,800 sq. ft. and are arranged 20 tubes wide by 26 high in three nests. With these two economisers the gas inlet and outlet temperatures at m.c.r. load are 1,230 deg. F., and 600 deg. F. respectively, and the water temperature is raised from 385 to 552 deg. F. A gas by-pass is arranged integral with the economiser to allow gases to pass from the superheater to the economiser outlet when required, and a cooler is installed in the by-pass to protect the dampers below. The heating surface of all four economisers is made up of cold drawn steel tubes on to which are shrunk cast-iron sleeves of the familiar

"H" pattern providing straight gas passages of uniform cross section. As is the case with most Senior economisers for modern plant, all pressure parts are butt-welded. Electrically-operated, Hopkinsons' soot blower units are supplied for all the boilers and are controlled automatically in sequence from a control panel located in the central control room. Steam for soot-blowing is taken from the secondary superheater inlet header.

Boiler mountings and valves

The mountings, valves, etc., for the boilers were supplied by Hopkinsons Ltd. The two main boiler drums are each fitted with local direct-mounted water gauges, the rear drum having also a remote water-level indicator (bi-colour) and an Igema water-level indicator—the latter being supplied by James Gordon & Co. Ltd. Both these indicators are located at operating floor level, with the Hopkinsons indicator repeated in the control room. Also supplied by Hopkinsons Ltd. were the water-level television equipment, torsion-bar safety valves (including electrically-assisted units), electric valve controls, pressure gauges, high- and low-water alarms, "Uniflow" valves, "Nolos" steam traps, safety-valve expansion chambers, safety-valve silencers, critical-pressure gauges with telemeter transmitting units, etc. Feedwater control is effected by the Copes "Flow-water" system supplied by Copes Regulators Ltd. The various isolating and control dampers are operated from the central control room by Ipscol actuators.

Automatic boiler control equipment

Control and operation of the plant is carried out from the central control room in which all the instrumentation and control apparatus is mounted on individual unit console desks, recorder and station control panels manufactured by Bailey Meters and Controls Ltd. The Bailey automatic combustion control equipment enables the boiler load requirements to be followed automatically, at the same time maintaining optimum combustion conditions throughout all variations of load. The Bailey system used is initiated by the measurement of steam pressure in the superheater outlet steam main as an index of load requirements. Should any deviation from steam pressure set point occur, an air signal is transmitted from the master pressure controller in the direction required, and proportional to the rate of change to effect an immediate corrective adjustment to the fuel and air supply to the boiler. Reset action is applied to this signal to enable the load change to be followed until stability is regained. The fuel supply is varied in quantity by conversion of the master signal change to a positional movement of a diaphragm-operated fuel-oil valve. At the same time as re-adjustment in fuel supply is taking place, the master signal initiates variations to the air supply of combustion and extraction of flue gases by adjustment of the forced-draught fan vanes and the induced-draught fan speed by means of hydraulic coupling control. To ensure that efficient combustion takes place, a continuous measurement of the air intake required for combustion is obtained and related to a measurement of the steam evaporation at the correct operating conditions. This relationship has been calibrated during combustion tests to provide coincidence of indication when the desired total air at any load value is flowing. Any deviation from this correct condition causes an air signal to be transmitted to the forced-draught fan control which re-adjusts the forced-draught fan output. At the same time, the furnace draught condition is measured by a furnace draught controller which is connected to a tapping through the furnace wall. Any variation to this furnace draught condition causes an air signal to be transmitted to the induced-draught fan control to re-adjust induced-draught fan output and maintain the correct balanced draught condition in the furnace. Considerable instrumentation covering the control, indication and recording of the draught, pressures, temperatures and flows, etc., including extensive telemetering, is taken to the centralised control room, so that not only can the normal functional operations take place, but also permits the starting up and stopping of the units on load control.

Oil-firing equipment

The oil-firing equipment, supplied by Peabody Ltd., is designed for remote control with push-button operation initiated at the main control desk. The oil-burners are of the Peabody flexible tilting type, seven installed in each corner of the furnace for tangential firing. Automatic gas-electric ignition, burner positioning, together with flame detection equipment, is incorporated in each burner, and continual indication of the operating state of each burner is given on the control panel. The Peabody constant differential pump system is used with return-type pressure atomisation giving an oil pressure at the burners of 600 lb./sq. in. at full load. A closed hot oil circuit is established at the boiler and the amount of oil that is fed into this circuit is equal to the amount that is fired from the burners. The quantity fired is also in direct relationship to the return oil pressure from the burners, thus producing a straight line characteristic which facilitates automatic boiler control. The automatic boiler control valve is installed in the feed line to the closed oil circuit. Considerable flexibility is incorporated in this oil-firing system which, in addition to the tilting burners for superheat control, gives a burner capacity turn down to at least 25 per cent. load with all burners in use. The burner selector switch on the control panel also enables any burner to be selected for lighting-up and putting on load, or extinguishing and purging for maintenance purposes at any time irrespective of the boiler load. A Peabody duplex pumping and heating unit supplies the heavy fuel oil to the burners with the pumps, strainers and heaters arranged to give 100 per cent. stand-by capacity.

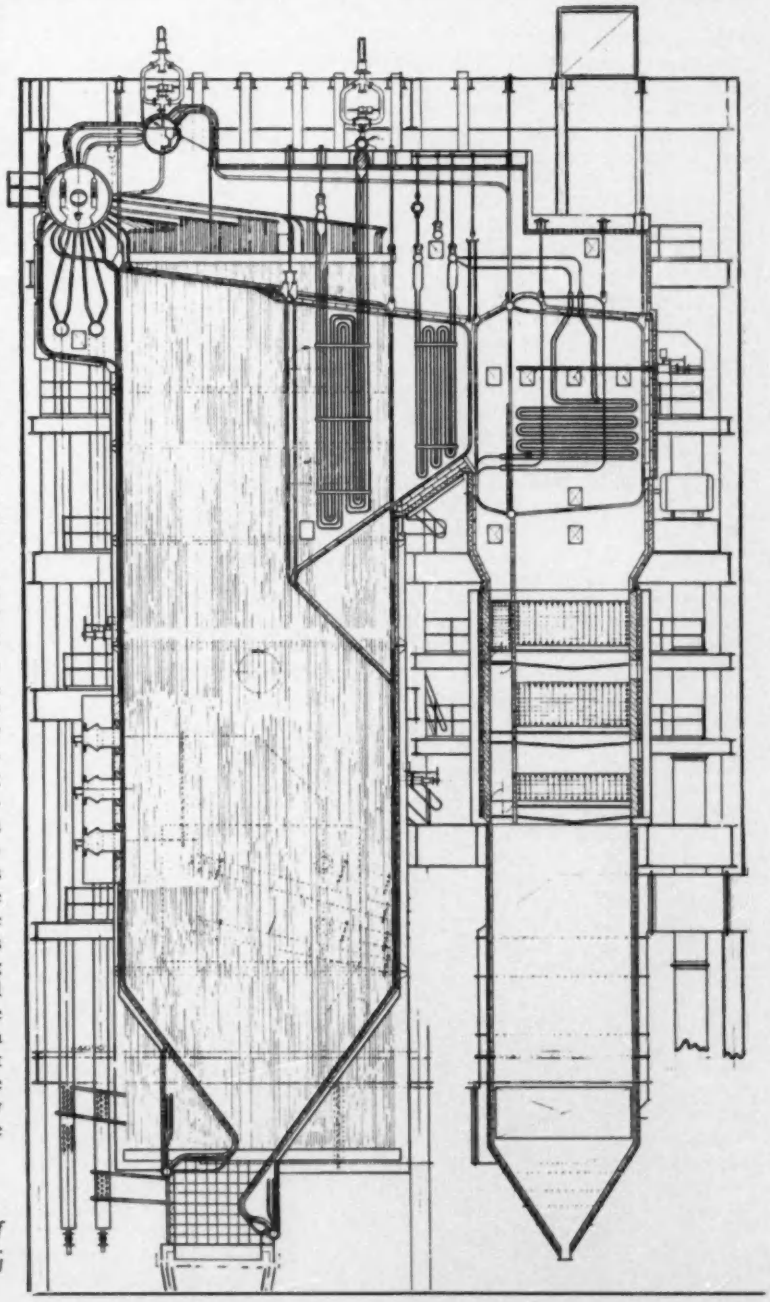
Mitchell boilers

Mitchell Engineering Limited are installing boilers Nos. 3 & 4, the capacity and steam conditions of which are similar to those of the International Combustion boilers. The feed temperature to the economiser is 385 deg. F. The boilers will be oil-fired but provision is made for future installation of pulverised-fuel equipment if required. The guaranteed boiler efficiency is 87.25 per cent. when burning oil having 85 per cent. carbon, 11 per cent. hydrogen and up to 5 per cent. sulphur, the gross calorific value being 18,400 B.Th.U./lb. For these two boilers, Associated British Combustion Limited are supplying and installing the oil-firing equipment and associated controls. The equipment comprises twelve burners arranged four wide by three high in the furnace front wall, each burner being complete with

high-energy spark ignition and flame failure devices. One Duplex pumping and heating set is provided for each boiler—the capacity of each pump being 45,000 lb./hr. Mirrlees " Imo "-type pumps are used, and they operate against a pressure of up to 600 lb./sq. in. at 1,450 r.p.m. The oil, which may have a viscosity of up to 6,000 sec. Redwood No. 1, will be heated to atomising temperature by hot water supplied at a pressure of 320 lb./sq. in. and 400 deg. F. A separate pump for circulating the oil during warming-up periods will be included. The boiler furnaces are of the radiant type with closely-pitched 2⅞-in. o.d. tubes ; the furnace volume is 46,000 cu. ft., giving a liberation rate of 15,350 B.Th.U./cu. ft. per hour. The main steam drum which is approximately 40 ft. long has an internal dia. of 5 ft. 6 in., and it is 4 in. thick. A steam receiver drum is also provided, both drums being of fusion-welded construction and supplied by G. A. Harvey and Company (London) Limited.

" MeLeSco " superheaters, manufactured by The Superheater Co. Ltd., will also be installed in the Mitchell boilers, and a similar arrangement to that for the International Combustion boilers, using primary and secondary sections and interstage spray desuperheaters will be incorporated. The first stage primary superheater will consist of a horizontal bank of 84 elements located in the rear boiler pass, and the second-stage primary of 42 pendent elements. The secondary superheater will be located at the furnace outlet behind two rows of boiler screen tubes, and will consist of 27 pendent elements, arranged at a pitch of 12-in. The total heating surface of the superheater is 18,625-sq. ft. As with the International Combustion boilers, the first stage primary elements will be supported on heat-resisting steel blocks welded to hanger tubes, and the second-stage primary and secondary elements will be suspended directly from the headers. A point of interest in the secondary elements on these boilers is the absence of any heat-resisting steel spacers between the individual tubes, spacing being effected by the use of direct tangent welding with suitable offsets to maintain the correct centres. The final steam temperature will be controlled automatically by means of two interstage spray-type desuperheaters. In addition, there will be manually-controlled gas by-pass dampers to divert the flue gases from the rear primary superheater section.

Two Howden Ljungström type XZW air-preheaters will be used, each heater having a heating surface of 57,100 sq. ft. Air recirculation will be employed to raise the air inlet temperature to the heaters and so inhibit corrosion troubles. As with boilers 1 and 2, the grit-collectors are of the Multivortex type and supplied by



Sectional elevation showing arrangement of one of the second pair of 550,000 lb./hr. boilers which are being supplied by Mitchell Engineering Ltd.

James Howden & Co. Ltd. There will be two collectors per boiler, each having 84 primary cells arranged twelve wide by seven deep.

The boiler insulation work, on boilers 1 & 2, viz., that for the drums, headers, integral piping, fuel oil piping, air-heaters, main flues, fans, ducting and dust-collectors, was carried out by The Darlington Insulation Co. Ltd. The drums, headers, and piping are covered with Darlington 85 per cent. magnesia slabs and/or sections except where the temperature exceeded 650 deg. F. where an initial layer of " Dextramite " high-temperature moulded insulation was applied. Finish in all cases was the usual ¼-in. hard-setting composition with calico pasted on and painted. The fans and dust collectors, which are " in the open," are covered with Darlington 85 per cent. magnesia slabs secured with wire-netting and supercoated with A.C.1 armouring compound. The four Howden air-heaters are covered with Darlington 85 per cent. magnesia slabs, finished with black mild-steel cleading. The Darlington Insulation Co. Ltd. were also responsible for the insulation of the oil-fuel tanks and oil piping, and for the evaporators—the latter being insulated with Darlington's " Dextramite " high-temperature plastic and 85 per cent. magnesia plastic. The evaporators are cleaded in blue planished steel.

The high-pressure pipework, low-pressure pipework and circulating water pipework for Nos. 1 and 2 sets was supplied by Stewarts and Lloyds Ltd. The high-pressure piping is of chrome molybdenum steel 14-in. o.d. by $\frac{13}{16}$-in. nominal thickness suitable for operation at a pressure of 1,030 lb./sq. in. and a temperature of 925 deg. F. The high-pressure feed-piping is of mild-steel $9\frac{5}{8}$-in. o.d. by $\frac{3}{4}$-in. nominal thickness, for working conditions of 1,350 lb./sq. in. and 385 deg. F. The Stewarts and Lloyds contract for the low-pressure piping included pipework for the low-pressure condensate system, feed-pump suction system, service water-piping, softened-water piping, and compressed-air piping. The contract for the circulating-water piping consisted of cast-iron pipework mainly of 42-in. bore.

The insulation work on the main steam-piping was carried-out by Versil Ltd., using Versil flexible glass-fibre blanket enclosed in wire-netting, the whole being enclosed in aluminium cleading. All flanges and valves are fitted with removable boxes lined with Versil glass-fibre. Versil Ltd. were also responsible for the anti-front protection for reserve feedwater and salt-water tanks, the protection material comprising cork board insulation, weather proofed with emulsified asphalt. This cork insulation material was also manufactured by Versil Ltd.

Turbo-alternator plant. (Nos. 1 and 2 sets)

The four 60-MW turbo-alternator sets are designed to operate with steam conditions at 900 lb./sq. in. and 900 deg. F. at the turbine stop valve, with the low-pressure cylinders exhausting at 28.9 in. vacuum to the condensers. The first two machines were designed and supplied by Metropolitan-Vickers Electrical Co. Ltd. The specified steam and heat consumptions when delivering 60-MW at 0.8 p.f. are 8.5294 lb./kWh and 9,314.5 B.Th.U./kWh respectively. Steam is extracted from the turbines at five points to heat the feed water to a temperature of 385 deg. F. The alternators are hydrogen-cooled at 15 lb./sq. in. Twin-shell condensors of Vickers-Armstrongs manufacture are provided for Nos. 1 and 2 sets. They are of the two-pass type with a total cooling surface of 57,000 sq. ft. Each condenser is designed to deal with 372,300 lb./hr. of steam, when supplied with 41,500 g.p.m. of cooling water under brushed tube conditions at a temperature of 60 deg. F. to maintain an absolute pressure of 1.1 in. h.g. The temperature of the condensate leaving the condenser shell was not to be less than 81.8 deg. F.

The turbines are two-cylinder machines with the high-pressure and low-pressure rotors rigidly coupled, and supported by three spherically-seated main bearings. That at the high-pressure inlet end is combined with a Michell thrust block. The cylinder casings are provided with annular steam belts at the extraction points enabling steam to be withdrawn from the complete periphery, instead of from localised areas, thus preserving thermal balance. The high-pressure rotor is machined from a one-piece ½ per cent. molybdenum steel forging with 19 integral discs carrying single rows of stainless-steel impulse blading. The double-flow low-pressure rotor, with six stages of stainless-steel single impulse blading in each flow, has separately forged and machined " Hykro " wheels shrunk on and keyed to the " Hykro " spindle. Steam is admitted to the high-pressure cylinder from two steam chests, situated one each side of that cylinder. Each chest carries an emergency stop valve and a governor valve. The emergency stop valves are operated automatically by duplicate emergency overspeed governors on the turbine spindle, set to operate at 3,300 r.p.m. In addition, the emergency valves may also be tripped instantly by hand. Turbine speed fluctuations are controlled by a centrifugal governor which operates the governor valves through an oil relay system, while hand and motor-operated speeder gear permits the raising or lowering of the turbine speed up to 5 per cent. above or below normal while the set is running. At 60-MW, m.c.r. steam exhausts from the low-pressure casing at a vacuum of 28.9 in. Hg. to the Vickers-Armstrong twin-shell condensers. A comprehensive supervisory control system is installed, with complete indicating and recording equipment, providing the turbine operator with all necessary information about axial expansion, running clearances and degree of eccentricity of the rotor. The steam turbines are direct-coupled to hydrogen-cooled generators of standard Metropolitan-Vickers design and manufacture. Each machine employs a hydrogen pressure of 15 lb./sq. in. and supplies three-phase, 50 cycle a.c. at 11.8-kV, 0.8 power factor.

Two electrically-driven extraction pumps per set, each capable of 100 per cent. duty, and two 3-stage steam-jet air-ejectors, together with a quick-start ejector, were also supplied. On the feed-heating side there are 3 l.p. and 2 h.p. feed-water heaters per set, plus a gland heater and drain cooler. One deaerator per set has also been incorporated.

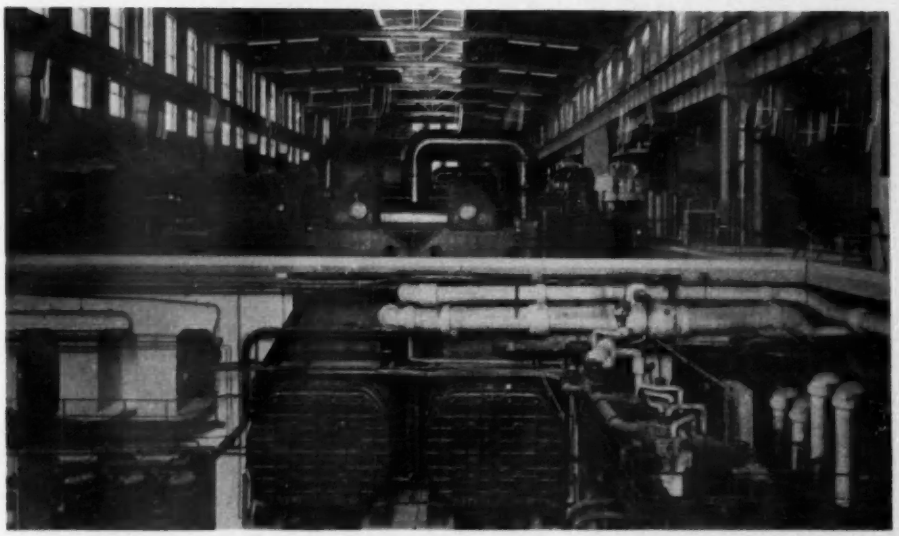
Circulating-water pumps

Tidal sea-water drawn from the River Yare through twin culverts leading to pump suction inlet chambers built into the turbine house foundations alongside each turbo-alternator set is pumped by two 50 per cent. duty pumps through each condensing set. This water on the outlet side of the condensers discharges via discharge chambers and culverts directly connected to

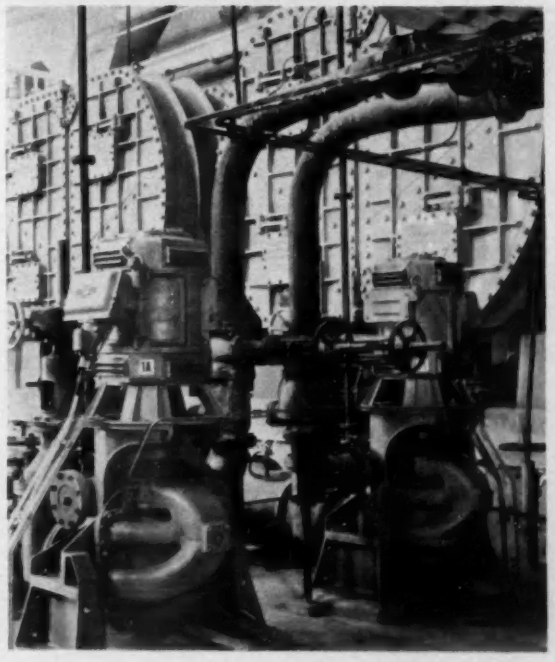
the North Sea. So that the pump, or pumps, serving each unit may discharge through the condenser the exact amount of cooling-water necessary to maintain the correct vacuum under any particular load condition, temperature of inlet cooling-water, state of cleanliness of the tube surfaces, etc., Vickers-Armstrongs, in conjunction with Evershed & Vignoles Ltd., have installed an automatic method for controlling an impeller pitch-changing mechanism built into the pumps, incorporating the use of a vacuum transmitter attached to the main condenser shell. This instrument transmits electrically to an electronic controller the condenser vacuum condition. The controller output signal is relayed in turn to an electro-hydraulic servo-motor positioned on top of the main pump motor. This servo-motor regulates the impeller pitch setting whilst the pump is running via a control rod running inside a hollow main pump and motor shaft, this rod acting as a connecting link, between servo-motor and the variable pitch impeller hub mechanism. Thus, any tendency for a change in condenser vacuum, caused by one of the above given reasons, is therefore immediately cancelled out by the increase or decrease in the amount of water being pumped due to a correction being made to the impeller pitch setting.

Four Vickers vertical-spindle 2-stage 30-in. dia. variable-pitch axial-flow pumps driven by Lancashire Dynamo constant-speed squirrel-cage motors have been supplied for sets Nos. 1 and 2. The total head on each pump is 28-ft., maximum specified output 22,500 g.p.m., pump running speed 480 r.p.m. with a pump efficiency at maximum specified output of 87 per cent. South Denes is the first power station in this country at which automatically-controlled variable-pitch axial-flow pumps have been installed, and four more identical pump sets to operate in conjunction with Nos. 3 and 4 turbo-alternators units are being supplied.

The second two 60-MW sets (Nos. 3 & 4) which are being constructed by Richardsons Westgarth (Hartlepool) Limited, are of Richardsons Westgarth-Brown Boveri impulse-reaction type. The turbines are of the two-cylinder type, having the i.p. and l.p. sections in one casing, the l.p. section being of quadruple-flow type. Steam consumption will be at the rate of approximately 506,880 lb./hr. (8.448 lb./kWh.) The alternators, which are hydrogen-cooled and consequently of smaller dimensions than those of normal air-cooled machines, are wound for 11,800 V, 3-phase, 50 c/s, 0.8 p.f. The hydrogen will be cooled by distilled water, at a pressure of 15 lb./sq. in. The condensing plants, which are also of Richardsons Westgarth (Hartlepool) Ltd. manufacture, are of their standard construction and of the single-shell type, each condenser containing 56,000 sq. ft. of cooling surface—of aluminium brass tubes—arranged in two passes. Duplicate condensate vertical extraction pumps made by Drysdale & Co. Ltd. are being provided, each being of two-stage type, capable of handling 900 g.p.m.



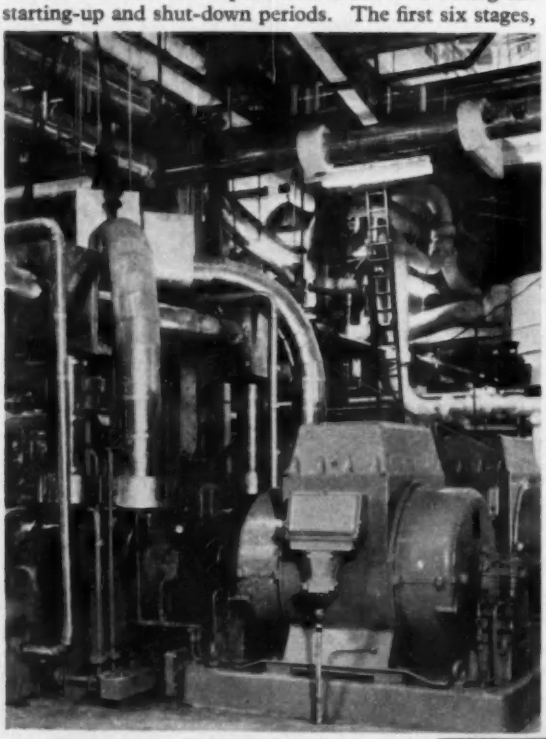
(Left). Nos. 1 & 2 turbo-alternator sets are 60-MW machines, and were supplied by Metropolitan-Vickers Electrical Co. Ltd.



(Below). The Drysdale condensate extraction pumps are driven by Metropolitan-Vickers 50 b.h.p. motors.

against a total head of 317 ft., and driven at a speed of 1,460 r.p.m. by a 50 b.h.p. electric motor. One emergency condensate pump, also of Drysdale manufacture but of horizontal split-casing type, will have an output of 550,000 lb./hr. against a 90 ft. head and will be driven at 1,450 r.p.m. by a 45 b.h.p. motor.

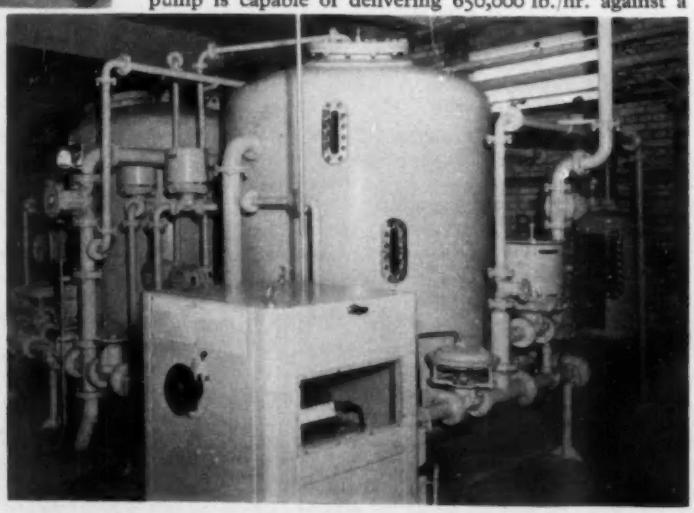
The first two machines are, as already stated, remote controlled by manually-operated individual push buttons. Following on this, it was decided that in the case of Nos. 3 and 4 sets the system of control should be extended; and as a result a master 12-stage hand-operated sequence controller has been developed, which automatically ensures that the correct procedure is followed during the starting-up and shut-down periods. The first six stages, commencing with the stage in which the operator would normally approach the machine and check that all the valves, etc., were in their correct position for starting up, cover the controlling of the auxiliary oil-pump, barring the turbine, bringing the condensate extraction pumps into operation, raising the vacuum and bringing the turbine up to a speed of about 2,800 r.p.m. (that is to say, the stage when the governor is ready to be brought into action). In stage seven, the turbine is brought up to full speed by the manual operating of the governor control. Stage eight covers the synchronising and loading of the machine and after use, the machine must be de-loaded and isolated from the bus bars before completing the remaining four stages which control the running down, hot barring and shut down of the set; the final stage being the position in which all the controls are rendered inoperative. Throughout the whole cycle, the operation of the machine is supervised by a magnetic interlock on the controller which prevents it from being turned to a further stage before all the conditions of the existing stage have been fulfilled. This interlock is not time-controlled but is entirely controlled by the actual operation of valves, oil and water pressures. In addition to the controller, provision is made to enable the machine to be operated by individual push buttons when required for testing or maintenance purposes. The standby extraction pumps, air ejectors, etc., may be brought into operation at any time during the running period by means of selector switches, without interfering in any way with the running of the plant. Electro magnetic transducers supervise the turbine while running and measure and record the vibration from each bearing, the eccentricity of the turbine shaft and the displacement of the rotor and cylinders. Should any of these factors reach a dangerous state, the alarm is given and the machine shut down.



(Above). There are eight Sulzer boiler feed pumps and they are driven by Metropolitan-Vickers HTAS type motors of 1,400 h.p.

Boiler feed pumps

For the four turbo-alternator sets there are eight boiler feed pumps manufactured by Sulzer Brothers (London) Ltd., each comprising one Sulzer electrically-driven pump of the horizontal high-temperature and high-pressure barrel-casing type, with six-stages. Each pump is capable of delivering 650,000 lb./hr. against a



(Right). The water treatment plant was supplied by John Thompson-Kennicott Limited.

total differential pressure of 1,160 lb./sq. in. with an inlet temperature of 265 deg. F. and when running at a speed of 2,970 r.p.m. The pumps are of the well-known Sulzer design and are provided with casings of cast-steel with cast-on suction and delivery branches, and cast-on feet for centre-line mounting. The end covers are of forged-steel, the impellers and guide wheels of nickel chrome steel. As is usual in the Sulzer design of pumps of this type, the hydraulic end thrust is automatically controlled by the balancing device with a balancing ring of forged chrome steel and balance wearing bush of alloy steel. Each pump is provided with a non-return valve and thermostatically controlled leak-off equipment made by Hopkinsons Ltd., and of the differential type, set to operate when the temperature differential between water entering the pump and that leaving the balancing device reaches a pre-determined figure.

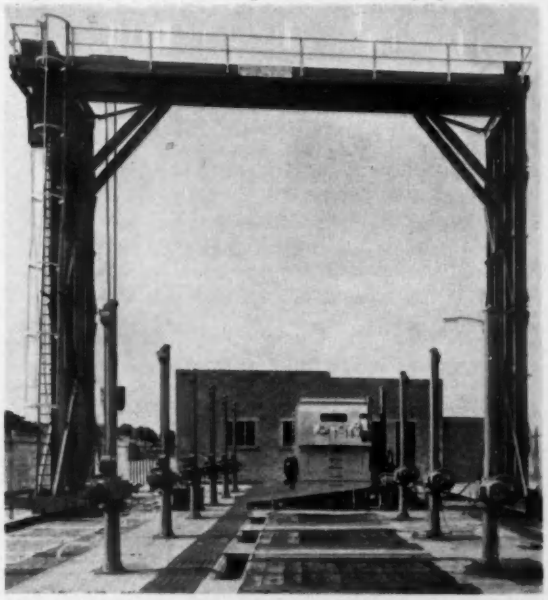
The feed pump motors, of which four are installed and a further four are on order, are of the Metropolitan-Vickers type HTAS, 1,400 h.p., 2,960 r.p.m., drip-proof pattern. In the type HTAS construction, a double-inlet system of cooling air circulation is employed. A propeller type fan is fitted at each end of the rotor core, and when the motor is running, cold air is drawn into the machine at both ends. The air is then directed over the end-windings and through axial ducts in the stator and over the periphery of the rotor core. It is then deflected through radial ducts in the stator core and finally discharged through a large aperture in the top of the yoke frame. (This type of motor is supplied with either drip-proof enclosure or alternatively as a totally-enclosed, closed-air-circuit machine with water-cooled air-coolers.) The extraction pumps are driven by four Metropolitan-Vickers type RS 105-h.p. squirrel-cage motors, and other motors for pump drive include twelve KN-B and GK squirrel-cage motors 1.5 h.p. to 150 h.p.

The main steam pipework, feed piping and blowdown piping for Nos. 3 and 4 sets is being supplied by John Thompson (Pipework) Ltd. The main steam pipework will comprise two 9-in. nominal bore leads from boilers to turbo-alternators, each line being manufactured from 10¾-in. o.d. by ¾-in. thick mild-steel piping having a 1 per cent. chrome and ½ per cent. molybdenum content. Designed pressure is 1,030 lb./sq. in. and the temperature, 925 deg. F. The feed piping will consist principally of 8-in. nominal bore (9⅝-in. o.d.) and will be made from ¾-in. thick mild-steel tubing. Designed working pressure is 1,350 lb./sq. in. and the temperature after the feed heaters, 385 deg. F. The blowdown pipework will "pick-up" from various blowdown terminal points on the boilers, and lines will be run to a blowdown flash-box, also supplied by John Thompson (Pipework) Ltd.

The Chemical Pump Division of The Candy Filter Co. Ltd. (now Metering Pumps Limited), supplied the low-pressure condensate chemical treatment plant. This equipment consists of duplicate plants each incorporating a precision variable stroke Metripump having a maximum output of 3.75 g.p.h. when operating at the fastest of six available stroke speeds, and at full length stroke. The length of stroke of the pump can be varied from zero to maximum either whilst the pump is in operation or at rest. A rubber-lined mild-steel chemical solution tank of 40 gal. capacity, complete with a Mitchell high-speed power-operated stirrer gear is provided, together with all necessary interconnecting chemical piping, stainless steel spring-loaded relief valves, stainless-steel injection fittings and change-over panel. Single-point pH recorders of Cambridge Instrument Co.'s manufacture are also included in the low-pressure condensate chemical treatment plant.

Sea-water evaporating plant

The first three machines are each equipped with two single-effect 10,500 lb./hr. evaporators. The heating steam is taken from a low-pressure bleed point and the vapour produced is passed to a condenser in the main boiler feed system, resulting in very high efficiency. The distillate from the evaporator having a conductivity of 10/15 Dionic units finally passes through a small de-ionisation unit which acts as a "polisher." These evaporators, installed to produce the very pure feed



The circulating-water screening plant was supplied by F. W. Brackett & Co. Ltd.

make-up, were designed and constructed by Aiton & Co. Ltd. The distinguishing feature of these plants is the heating element which consists of non-circular tubes arranged in specially-formed banks to promote a high rate of heat transmission.

South Denes is only the second large modern power station in this country to be supplied with boiler make-up from sea-water. This is an important development in power station design, in view of the large quantities of water demanded by new stations, from already over-taxed public supply systems.

Water treatment plant

From the evaporation and distillation plant the distillate is passed through anthracite filters and a mixed-bed deionisation plant supplied by John Thompson-Kennicott Ltd. The treated water from the Kennicott plant has the following maximum characteristics :—

Conductivity	..	0.5 reciprocal megohms
Silica ..	..	0.05 p.p.m.
Ammonia ..	..	Nil
Carbon dioxide	..	Nil

Each mixed-bed unit has a capacity of 8,400 gal./hr., but when operated in parallel can produce 16,800 gal./hr. They operate at a temperature of 130 deg. F.

A feature of the plant is the semi-automatic operation applied to the mixed-bed units. On a unit becoming exhausted, it is automatically taken off line, and the standby unit automatically brought on to line. All control valves on the mixed-bed units are operated pneumatically from a single control station, the operator selecting in sequence twenty-four control positions. If manual control had been used, to complete a regeneration of a mixed-bed unit would involve 60 separate valve operations. The mixed-bed deionisation units are equipped with Rohm & Haas Amberlite resins and for regeneration 30 per cent. hydrochloric and caustic soda are utilised. The 30 per cent. hydrochloric is stored in 2-12½ ton ebonite-lined storage vessels which are positioned over a concrete effluent tank into which the acid and caustic effluents discharged during regeneration are received. Measurement of conductivity of the final water is recorded and the recorders are fitted with pre-set contacts so that on conductivity rising to a pre-determined level a mixed-bed unit is taken off line and the standby unit brought into line.

Nos. 1 and 2 generators are each solidly coupled to a 72-MVA, 11.8/35.4-kV generator transformer and a 5-MVA, 11.8/3.42-kV unit transformer. The generator transformers feed on to the 33-kV busbars of the existing Yarmouth switching station, which in turn, feeds one 7.5-MVA, 33/3.45-kV station transformer.

Nos. 3 and 4 generators will be solidly coupled to a 72-MVA, 11.8/132-kV generator transformer which will feed a new 132-kV switching station. The 132-kV busbars will be connected with the existing 33-kV switching station.

Control consoles for the first two unit sets

ELECTRICITY SUPPLY BOARD (IRELAND)

In our September issue we published a general description of the Ferbane (Co. Offaly) power station of the Irish Electricity Supply Board. As pointed out in our description, this £4 million station, the first of its kind outside Russia to use milled peat as fuel, was to be formally opened on Monday, September 15th.

The opening ceremony was performed by Mr. Sean Lemass, Minister for Industry and Commerce, who, speaking at a luncheon at Athlone afterwards, said that assuming an average 7 per cent. annual increase in the growth of demand for electricity in Ireland, they would have reached a position in about 10 years hence—say 1969—when all important native sources of power generation, from either solid fuel or water power would have been fully utilised. All the generating stations in the present and next E.S.B. programmes would have been fully developed, together with the remaining hydro-electric potential, and the large peat bogs capable of mechanical development.

They must, therefore, take note that the next following step in the programme of construction, or renewal of generating plant, may take the form of a nuclear reactor station. The development of nuclear energy for power was more expensive than conventional methods, and Ireland had no economic interest in the use of nuclear energy unless it was cheaper than present methods, or had some compensating advantages. Within five years, however, it might have become a fairly routine, safe, and economic operation. By the time the E.S.B. development programme was complete, peat fuel production would have reached 2 million tons of milled peat, and half a million tons of sod peat per annum; 60 per cent. of the country's total demand for electricity would then be provided from native sources.

The Ferbane station was the first in western Europe to use milled peat; the decision to turn to milled peat being based on the confidence that was felt in the Bord na Mona (Turf Board) organisation to supply it, and in the E.S.B. engineers to design stations to use that type of fuel efficiently. The switch over to milled peat came largely on the initiative of Bord na Mona. Its faith in the advantages of milled peat had been more than justified by the results achieved at Ferbane. It was clear from the present annual report of the E.S.B. that the fuel cost per unit of electricity sent out from Ferbane was significantly lower than that from coal or oil-fired stations—and the figures concerned related to a year in which the station was only in partial operation. In future, it was reasonable to expect that its economies would improve even further.

Mr. R. F. Browne, chairman of E.S.B., welcoming the guests, said the growth in the use of electricity continued, and as yet showed no sign of any point of saturation. There were now 19 power stations all over the country—eight hydro, six sod-peat, one milled peat, and four coal or oil. In addition, five other stations were under construction. "What is being done now will in no way interfere with a nuclear power programme when it becomes feasible and economic to introduce it."

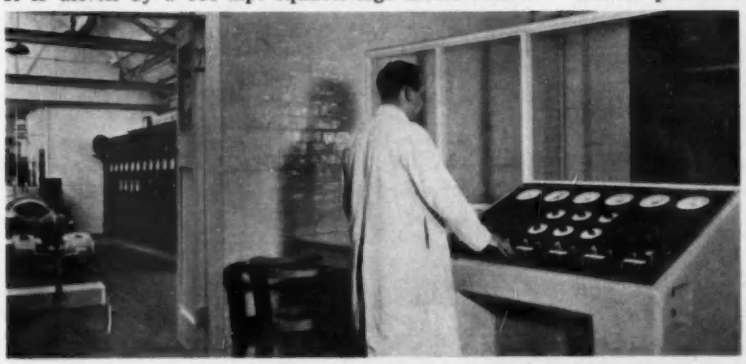
Power produced from hydro stations happened to be the cheapest, but only 30 per cent. of potential water power in the country remained undeveloped. The rural electrification scheme would soon be completed, and an important result of the supply network throughout the country was the ability to decentralise industry, because power would be available in almost every area. Electricity had remained relatively cheap, and there were few services of commodities which could show somewhat less than a 50 per cent. increase in price over the last twenty years.

The Central Electricity Generating Board has received the consent of the Minister of Power to the establishment of a new power station at Richborough, Kent. The total installed capacity of the station will be 360-MW, and the plant will consist of three 120-MW turbo-generator sets, together with three reheat boilers each designed for an evaporative capacity of 860,000 lb./hr. of steam. Steam conditions will be 1,500 lb./sq. in. at 1,000 deg. F., with reheat to the same temperature. The first generating set is scheduled for commissioning in 1962.

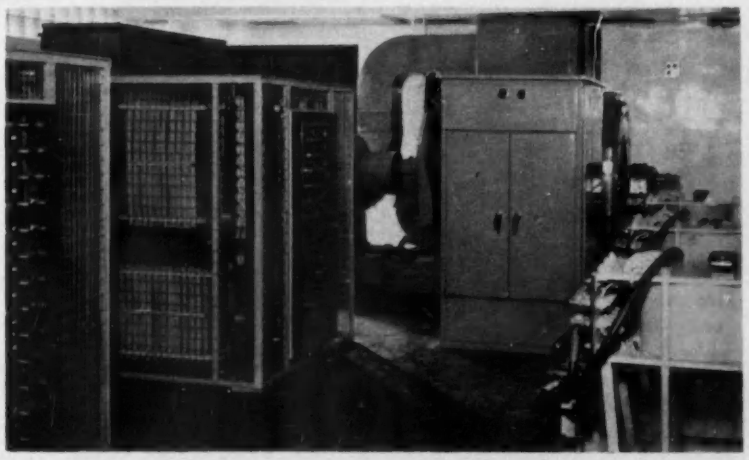
A Short-Circuit Test Station

WE were recently invited to visit the Lincoln works of J. A. Crabtree & Co. Ltd., at Walsall, Staffordshire, where the company have established a new short-circuit test station, designed for circuit-breaker and contactor testing on currents of up to 10,000-A at 440-V, 3-phase. From its inception the company has conducted a continuous programme of research in those fields directly concerned with the performance of its products and productive equipment. Today high-power photomicrography, fatigue analysis, hardness testing extending from very hard steels to soft rubbers, analysis by absorption meter and many other test procedures requiring highly specialised equipment are used in the metallurgical and chemical laboratories. The electrical laboratory has a range of a.c. and d.c. supplies available, and a wide variety of measuring instruments ranging from simple ammeters to a magnetic oscillograph for the examination and recording of transient phenomena. The Crabtree laboratory is also provided with apparatus for electrical testing at elevated temperatures and humidities.

The alternator provided in the new short-circuit test station is rated for an output of 800-kVA, 440-V, 3-phase 4-wire, and has a rotating salient pole field. It is driven by a 100-h.p. squirrel-cage motor with a synchronous speed of 1,500 r.p.m. This is controlled by an auto-transformer starter employing a Korndorffer circuit. The two machines are directly coupled and, together with a directly coupled exciter, are mounted on a common bedplate. Current is fed direct from the alternator terminals to a main circuit-breaker which has a normal continuous rating of 1,000-A, and a breaking capacity far in excess of the maximum short-circuit current of the alternator. Leading from the alternator is a network of underfloor busbars terminating in the testing cell. Placed between the circuit-breaker and the terminal board are reactors and resistors connected in each phase so that prospective current and power factor can be controlled down to 100-A. A "make" switch is situated in the test cell and provided with an electronically operated point-on-wave control. Remote control of the whole station is provided from a control desk in the test bay directly in front of the test cell. Automatic safety devices and signals are incorporated. The machine with its starter and the circuit-breaker, the resistors and the reactors, are situated in a specially built room which has forced ventilation, the incoming air being filtered to exclude dust. Lying between the machine house and the test cell is a small dark-room so that the oscillograms can be processed with the minimum of delay. The test cell is also provided with a d.c. supply from a stationary battery capable of giving 5,000-A, at 250-V and over 2,000-A at 500-V. Suitable control resistances are situated in the test station. Provision is made in the busbar system for the connection of transformers for higher test voltages. Ample room for viewing tests by upwards of thirty observers has been provided in the test bay and there is a conference table for the examination of apparatus before and after test. The test bay has been arranged particularly



(Above). Remote control of the whole station is provided from a control desk in the test bay, directly in front of the test cell.



(Right). The alternator room, showing (left) the resistor banks, and (right) the capacitors.

to suit tests on apparatus intended for manual operation by unskilled operators—an example of such apparatus being miniature circuit-breakers which may be installed in domestic premises or institutions and re-closed after a short-circuit by a housewife or nurse. Under these circumstances it is most important to be able to observe the action of the circuit-breaker at close quarters and in quiet conditions. These requirements are complied with in the layout of the test bay, and in this respect the Crabtree test station differs from the larger short-circuited testing stations on the heavier side of the industry.

Here it may be of interest to recall that the company commenced operation in 1919. The Lincoln works, which today employs nearly 2,000 persons, occupies a site of over seven acres, and was built in 1923. It is largely a self-contained factory in the layout of which the component manufacturing departments are grouped around the periphery of the site and are served by a network of internal roads. These roads enable raw materials to be delivered to stores adjacent to the point of usage, and for finished components to be transported to the components stores of the two main assembly shops. Each of the assembly shops has its own warehouse from which the finished products flow by gravity conveyors to a common packing and despatch department. Works administrative offices are above the assembly shops and have direct internal access to all works departments. The sales and other offices are also above the works and are in direct communication with the warehouse and despatch departments below. In the development of these works, the company has pioneered many innovations and productive techniques and was the first wiring accessories manufacturer to establish research laboratories. It was also the first in the accessory field with a plastic moulding plant; and was among the first factories in the Midlands to install a fully mechanised foundry. The Crabtree Company was also among the earliest users of the punched-card system of statistical control. The company has been compelled to find productive capacity in other areas and an existing factory at Lanesfield, near Wolverhampton having a site area of 2½ acres, was acquired in 1947, whilst a new factory site of five acres is being developed at Brownhills, near Lichfield.

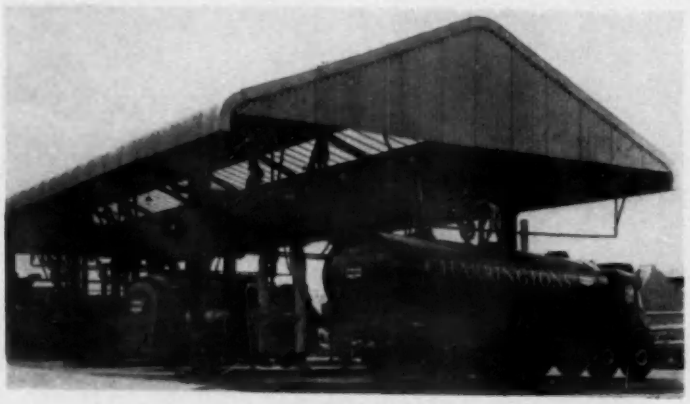
A Modern Fuel-Oil Terminal

UNDER a long-term agreement negotiated in 1953 with the Mobil Oil Co. Ltd., Charrington, Gardner, Locket & Co. Ltd. are sole distributors throughout twenty-four counties in England, of the full range of fuel oils produced at the Mobil refinery, Coryton. To carry out this undertaking, Charrington's have built up a fleet of road tankers, rail tank cars and oil barges, with storage terminals at Norwich, Cambridge, and Bedworth (near Coventry). On Monday, September 15th, a further storage terminal, with a storage capacity of over 4 million gallons, to serve the increasing number of customers in the London area, and constructed at a cost of approximately £400,000 on a ten acre site formerly occupied by Poplar Dock, was officially opened by Mr. J. C. Gridley, chairman, Mobil Oil Co. Ltd.

Storage facilities at Poplar comprise one 4,000-ton capacity tank for Mobilheat; one 6,500-ton capacity tank for Mobilfuel Light, and two further tanks of 4,000 tons capacity for Mobilfuel Medium and Heavy. All the tanks were manufactured and constructed by W. Neill & Sons Ltd. The four fuels will be transported by river, in 200-ton steel barges, from Coryton, and at Poplar will be discharged by one of three cargo pumps provided on a 700-ft. long quay. The pumps were supplied by Mirrlees (Engineers) Ltd., two being of 120 tons/hr. capacity, driven by English Electric 40 h.p. 3-phase induction motors running at 980 r.p.m., and the third of 54 ton/hr. capacity, driven by a 15 h.p. motor running at 1,450 r.p.m.

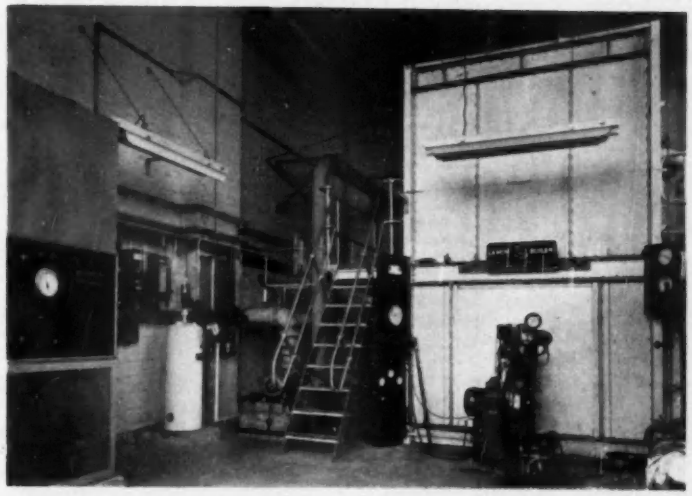
To transfer the oil from the storage tanks to the road-tanker loading bays, special automatic equipment is used, so that manual control is eliminated, unless required. A battery of eight pumps, two for each grade of fuel, is provided, and these are controlled by fully-automatic switch-gear, arranged so that according to the number of road-tankers loading, more or less pumps are brought into operation, up to a delivery rate of 1,200 gal./min. of each grade. Six of these pumps, each of 600 gal./min. capacity, of the positive-displacement type, and operating in conjunction with three hydraulic accumulators, were supplied by Plenty & Son Ltd., and two (for gas oil) each of 500 gal./min. capacity, were supplied by Lee, Howl & Co. Ltd. Pressure on these latter units, which are of the centrifugal type, is maintained by a booster pump. Dicks Asbestos & Insulating Co. Ltd. were responsible for the lagging of the necessary pipework. There are eight loading bays, each with three loading arms capable of delivering oil at 300-gal./min. A ticket printing meter associated with each arm, automatically records the amount of oil loaded on a ticket issued to the driver when he is given delivery instructions.

Ancillary services include a special two-



A view of the loading bays, each of which has three loading arms capable of delivering oil at 300 gal./min.

bay vehicle wash-down building, and the hot-water for this facility, and for heating the storage tanks is provided by a 6,500,000 B.Th.U./hr. boiler supplied by La Mont Steam Generator Ltd., and installed by Matthew Hall & Co. Ltd., the main heating engineers for the entire project. The boiler which operates at a water temperature of 230-240 deg. F., and a pressure of 43-48 lb./sq. in., burns 1,000 sec. fuel oil, preheated to 250 deg. F. and fired through an oil burner unit supplied by Fuel Firing Ltd. In connection with the boiler plant, Mirrlees (Engineers) Ltd. supplied the 40-gal./hr. capacity oil-circulating pump, and Holden & Brooke Ltd. two water-circulating pumps, each with a capacity of 100 gal./min. at a 40-ft. head, and driven by 3-h.p. induction motors, supplied by English Electric Ltd. Kelvin & Hughes (Industrial) Ltd. supplied the instruments associated with the boiler plant, including a smoke obscuration meter and indicator, CO_2 indicator, temperature indicator, and B.Th.U. meter, while Drayton Regulator and Instrument Co. Ltd. manufactured the automatic burner control. Nitrogen-pressurising equipment for the hot-water system was supplied and installed by Matthew Hall & Co. Ltd.



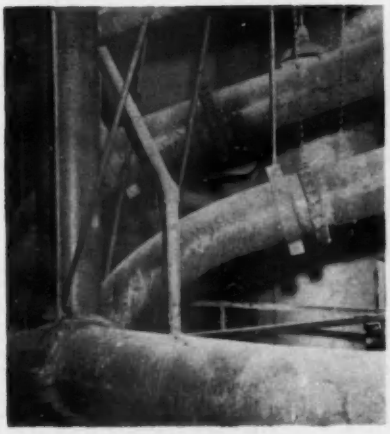
Interior of the boiler house showing the La Mont boiler, and on the right the nitrogen-pressurising equipment for the hot-water system.

A second boiler—a Spanner "Swirly-flow" unit, of 2,000 lb./hr. capacity—provides steam for barge-heating, while compressed air services are catered for by two 136 h.p. compressors of Broom & Wade Ltd. manufacture.

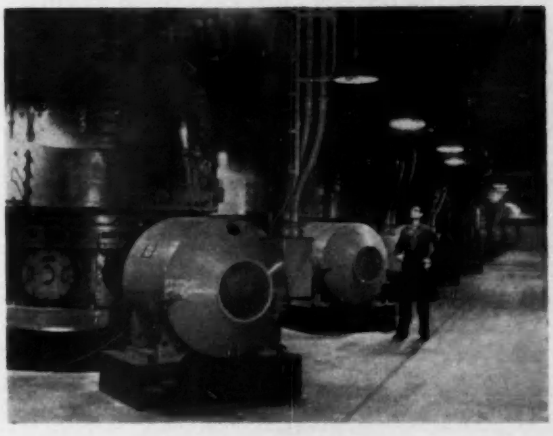
When considering the very modern facilities provided at Poplar, it is worth recalling that the consumption of fuel-oil in the United Kingdom, although less than two-thirds that of petrol in 1953, is now much greater. In the first six months of this year, for example, it was 5,031,038 tons compared with 3,146,435 tons of motor spirit. The use of fuel oil has doubled over the last five years, and is expected to double itself again by 1967.

Silicone Rubber Seals for High-Temperature Couplings

IN order to reduce maintenance costs in respect of the large number of couplings employed in the pulverised-coal pipelines which connect the pulverising mills to the boiler burners at the Astoria station of the Consolidated Edison Co. of New York, silicone rubber is now being utilised instead of conventional rubber for sealing high-temperature couplings. A total of some 234 flexible couplings, spaced on an average every 10 ft., are used throughout the system. Temperatures of the pre-heated pulverised-coal handled is approximately 150 deg. F., while the ambient temperatures, especially near the boilers, are as high as 325 deg. F., and due to the heat, the life of the conventional seals in the expansion joints was limited to an average of six months. Occasionally a failure occurred within a period of perhaps one week after installation. Although the seals themselves were not expensive, their replacement necessitated shutting down the plant; and this, together with the labour



(Left). "Victualic" couplings in position on pulverised-coal pipe-lines.

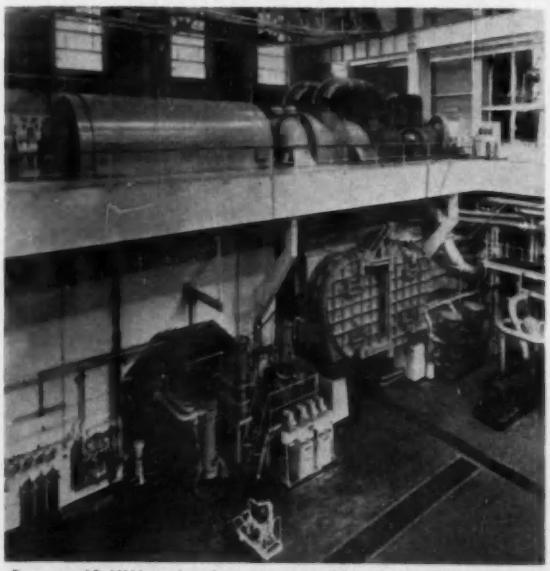


(Right). A general view of the coal pulverising mills at the Astoria station of the Consolidated Edison Co.

involved, resulted in the cost of a single coupling ranging from £16 to £32. In contrast, silicone seals have remained in service for periods of more than a year, and thus their cost has been recovered several times over, in spite of the high initial cost of the new seals as compared with those of conventional types. The main difficulty involved in the sealing of pulverised fuel pipelines is that they operate intermittently rather than continuously, and at elevated temperatures. This creates a problem due to the expansion and contraction of the piping. The jointing now being used at the Astoria station is known as Victualic, and this is claimed to provide for, or absorb, movement of up to ½-in. separation, varying with the type and size of pipe at the pipe ends. In addition, the Victualic couplings are claimed to be simple and easy to install, while being substantially more economical than flange joints or other conventional jointing methods. The silicone rubber gaskets employed are, it is understood, suitable for use with temperatures as high as 500 deg. F. and for indefinite periods. Consisting of only three components—a single gasket and two housing clamps—the Victualic couplings mechanically lock the pipe-ends together so that they cannot blow-off under pressure, or pull out should they be subjected to vibration or sagging.

600-MW LIQUID-COOLED GENERATOR

In the design of electrical generators for an output of 200-MW and above, the limitation in size for transportation becomes a major problem. C. A. Parsons and Co. Ltd., Heaton Works, Newcastle upon Tyne, have, therefore, decided upon a more efficient cooling system for their larger generators, allowing for a greater output from the machines for a given frame size and temperature rise. This system uses water-cooling of the stator windings, where the cooling medium comes into direct contact with the conductors, thus removing the heat from the point of generation and relieving the insulation of thermal gradients. Following development work carried out by the company at Heaton of liquid-cooling of stator windings, a 60-MW generator employing this system as well as hydrogen-cooling was commissioned in December,



Parsons 60-MW turbo-alternator set (No. 4) at Tilbury Power Station. This machine employs liquid coolant (demineralised water) for the stator windings.

1957, at Tilbury generating station. The liquid coolant (demineralised water) flows through the conductors in parallel from one end of the winding to the other. Each conductor terminates at both ends in water-boxes moulded from an insulating material. There are two boxes per phase, making a total of six at each end of the stator. The distilled water is circulated by a small pump and is cooled by means of a heat-exchanger which is connected in parallel with the main hydrogen coolers also using distilled water. The experience gained during the manufacture of this type of water-cooled stator, and the information obtained from the resulting tests, have demonstrated that direct-cooled generators can be built for outputs of the order of 400-MW without exceeding the present transport limits in this country.

METROPOLITAN-VICKERS PLANT FOR AUSTRALIA

In the September issue of this journal we referred to the latest extensions that are to be made to the vast Yallourn Power Centre of the State Electricity Commission of Victoria, Australia. The new station will be known as Yallourn "E." As mentioned in our previous reference, a contract worth more than £5 million has been awarded to Babcock and Wilcox of Australia Pty. Ltd. (a subsidiary of Babcock and Wilcox, London) for two 950,000 lb./hr. boilers and their associated auxiliary equipment.

Now, a contract worth nearly £4½ million has been awarded by the State Electricity Commission to Australian Electrical Industries Pty. Ltd. (a subsidiary of Metropolitan-Vickers Electrical Co. Ltd., Manchester) for the turbo-alternator plant and electrical equipment for Yallourn "E." As with the B. & W. contract, much of the plant (more than £2 million worth) will be manufactured at the Metropolitan-Vickers works at Trafford Park, Manchester, and elsewhere in this country, thus directly aiding United Kingdom exports. The plant to be manufactured in England will comprise the turbo-alternators and associated mechanical auxiliaries, and electrical equipment including motors, transformers, switchgear, etc. The rest of the plant will be manufactured in Australia by subsidiaries of British companies. The new contract is for two 120-MW turbo-alternators, each complete with its own condensing plant, feed heating plant, and circulating-water system. Each turbine will operate with steam conditions of 1,500 lb./sq. in. and 1,050 deg. F. The contract also includes six electrically-driven boiler feed pumps (three for each set), and these will be made by Mather and Platt Ltd., Manchester.

SEA-WATER DISTILLING PLANT

The Guernsey Water Board have made an historic decision by ordering from G. & J. Weir Ltd. the first sea-water evaporating and distilling plant for commercial operation in a country with an adequate rainfall. The economy of Guernsey depends upon sufficient fresh-water supplied for its fruit and flower industries, and the new Weir plant will ensure these supplies even if drought conditions prevail locally. The installation will produce half a million gallons of fresh-water daily from the sea, and in making use of the Weir Multiflash method, the Guernsey authorities have found that it will prove cheaper than building reservoirs and catchment areas to collect rain. This is because the design of the plant allows very high rates of fresh-water production per unit of heat input for much lower capital cost than was previously possible. This new method of producing fresh-water is an important fundamental development, even for countries with an ample rainfall, as in addition to considerably reducing capital outlay, it can also be designed to combine the economic production of electricity and "soft" water for industry as well as domestic supplies. G. & J. Weir Ltd. plant now produces three-quarters of the world's output of fresh-water from sea-water, and it is anticipated that the Guernsey plant will be completed and commissioned early in 1960. It will take the form of a fabricated mild-steel structure, 70-ft. long, 19-ft. wide and 19-ft. high, internally divided into various "flash" and preheater sections. A de-aerator unit will reduce to a minimum the causes of corrosion by removing gases dissolved in the incoming sea-water, and chemical treatment of the sea-water will prevent scale formation on the internal surfaces of the plant.

INDUSTRIAL *Fuel Efficiency Exhibition*

Amber Chemical Co. Ltd., 11a, Albemarle Street, London, W.1

The Amber Chemical Co. Ltd. exhibited a wide range of liquid fuel improvers and combustion additives. A special feature was Amber SSR 513 Diesel oil treatment, exhibited for the first time, while the display also included the latest Amber patented injection system as supplied to major industrial installations and power stations, where Amber combustion additives are proving highly successful. The Amber Chemical Co. Ltd. is one of the Amber Group of Companies, with which are associated Amber Oils Ltd., Charles H. Windschuegl Ltd., and Causeway Reinforcement Ltd., companies which specialise in the manufacture of products designed to effect economies and to be of benefit to all industrial fuel consumers.

Auto-Combustions (London) Ltd., 360/364, Wandsworth Road, London, S.W.8

This firm, who are specialists in the manufacture of oil-firing equipment for boilers and various types of furnaces, exhibited their "Swirlamiser" medium-pressure (air and steam) oil burners which are applicable to all types of boilers and industrial furnaces, rated from 50,000 to 10 million B.Th.U./hr., direct and indirect air-heaters, ceramic and brick kilns, road-making machines, galley ranges, etc., and the conversion of gas-fired boilers. A continuous colour film showed these burners in operation. Also featured were the "Autoflame" pressure-jet oil-burners suitable for all boilers of capacities from 80,000 to 300,000 B.Th.U./hr., the "Vapormiser" fan-assisted, horizontal flame vaporising burner (shown firing) suitable for domestic boilers, and industrial air-heaters, and for capacities from 28,000 to 120,000 B.Th.U./hr.

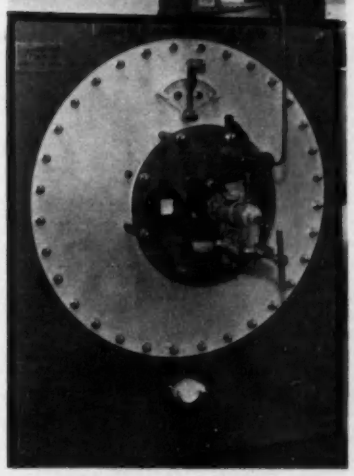
Babcock & Wilcox Ltd., Babcock House, 209, Euston Road, N.W.1

The displays on the Babcock & Wilcox stand included exhibits of plant and equipment by subsidiary companies of the organisation :—Edwin Danks & Co. (Oldbury) Ltd., Spencer-Bonecourt-Clarkson Ltd., and Fireye Controls Co. Ltd. Prominent amongst the full-scale exhibits was the new Renfrew stoker. This is a "packaged" stoker for the quick, low-cost conversion of existing hand-fired water-tube boilers to mechanical stoking with all the advantages of economical smokeless firing using low-grade fuels ; and which is also available as specified equipment on new boiler plant, with capacities up to about 25,000 lb. steam/hr. Also featured was the new corner-tube hot-water boiler which is a compact and versatile forced-circulation boiler for modern high-pressure hot-water heating and process systems. This exhibit was fitted with the Oldbury "air-spin" oil-burner, an air-turbine driven rotary-cup burner of extremely simple design, in which perfect combustion of the heaviest fuel-oils is achieved at relatively low temperatures, with a consequent reduction in oil heating costs. An animated display explained the principle and operation of the Edwin Danks thermal storage boiler, which combines in a single unit, the functions of steam generation and heat storage. Among other interesting exhibits were a model of a Spencer-Bonecourt waste-heat boiler which is widely used in the gas, steel, glass, chemical and other industries. Spencer-Bonecourt-Clarkson Ltd. exhibited an oil-fired BATO/65 thimble-tube boiler which is a compact, vertical-type boiler unit, renowned for rapid steam-raising and requiring a minimum of maintenance and attention. A display of "Fireye" flame-failure safeguard equipment demonstrated its application to installations of both non-automatic and fully-automatic burners. The equipment may be fitted to all forms of power or industrial boiler plants, water-tube or shell-type boilers, whether fired with oil or gas.

The Industrial Fuel Efficiency Exhibition was held at Olympia, London, from September 24th to October 3rd, 1958. It was formally opened by Earl Attlee, K.G., O.M., C.H., and nearly 170 manufacturers of equipment designed to achieve fuel economy in all branches of industry exhibited representative examples of their products.

Bailey Meters & Controls Ltd., Purley Way, Croydon

The Bailey smoke density indicator and alarm equipment was shown in operation, together with the new operations recorder which can record up to two independent alarm conditions. The electrical impulse signal is transmitted from any instrument fitted with alarm contacts. The well-known Bailey boiler meter which measures steam flow and air-flow, and records these on a common chart was also exhibited, as was the Bailey area meter which is suitable for measuring the flow of viscous fluids. Various versions of temperature equipment were shown including 4-in. and 8-in. edgewise indicators, strip-chart and circular-chart recorders and also the new Bailey 4-pen change-over mechanism which not only records four temperatures, using a single amplifier and servo-motor mechanism, but can also be used on telemetering systems. A new addition to the Bailey range of equipment, the Bailey oxygen and combustibles recorder was also shown ; this instrument is suitable for inclusion in control schemes if required. The Bailey solids flow failure transistorised equipment was demonstrated in operation, as was the acoustic flame failure device.



The Bailey Meters flame-failure device, which was demonstrated on that company's stand during the exhibition.

Bennis Combustion Ltd., Little Hulton, Walkden, Manchester

An 8-in. chain and bucket elevator arranged in front of a Bennis chain-grate stoker and a "Low Ram" stoker, was included as a working exhibit on the stand of Bennis Combustion Ltd. The Bennis chain-grate stoker for shell boilers, small water-tube boilers and furnaces is suitable for burning a wide range of solid fuels and is completely smokeless in operation. Also suitable for shell and small water-tube boilers and furnaces is the "Low Ram" stoker. Smokeless and noiseless in operation, it can burn efficiently the widest possible range of fuel. The chain and bucket elevator, suitable for boilerhouse applications, can handle 1½-tons of coal per hour at a chain speed of 50 ft./min. Also displayed was a "Minimeter"

underfeed stoker, one of the "Meterfeed" range of underfeed stokers, all of which embody the controlled feed principle, and which are suitable for boiler, kiln and furnace applications.

Black Automatic Controls Ltd., Leafield, Corsham, Wilts.

The Black Automatic Controls Ltd. display included a range of solenoid-operated shut-off control valves from ¼-in. to 1-in., developed in conjunction with a number of the leading oil burner manufacturers to meet the increasingly arduous and complex duties called for in current industrial and domestic oil burner practice; and a newly developed solenoid-operated lever valve designed to cater for increasingly high viscosity oils now being used. This valve embodies a unique feature in that the plunger and seat are assembled in a reversible cage thus enabling the same valve to be used either "energised-to-open" or "energised-to-close." A number of the larger standard valves included in the above ranges can also be supplied in diaphragm-operated form with or without the control relay valve. Also displayed were pneumatic and hydraulic control valves, and a comprehensive selection of pressure switches ranging from a small pressure cut-off switch of the type used on diesel engines up to high-pressure switches to operate at 10,000 lb./sq. in.

Keith Blackman Ltd., Mill Mead Road, London, N.17

Exhibits on the Keith Blackman stand included, two high-pressure blowers for supplying air blast for combustion to oil and gas-fired furnaces; a high-temperature bifurcated-type axial fan for recirculating hot air or other gases; a steam heated unit heater for space heating purposes in factories, workshops and public buildings, and a selection of industrial gas apparatus including an air or gas compressor for supplying pressures up to 5 lb./sq. in., a Type 3 mixture controller for the accurate control of air/gas mixture ratios; burner nozzles, injectors and a thermostat complete with relay governor. Also on the stand was a working model of the Keith Blackman-Broman Ekstrom shot cleaning system which ensures maximum heat transfer in heat exchangers; a 10-in. size induced-draught and grit-arresting fan; a model of a PD-KB multitubular dust collector used for the removal of flyash from flue gases of power stations and medium size industrial boilers; and finally a Type AR aerofoil section, backward bladed impeller of the high efficiency type widely used for induced draught.

Bolton's Superheater & Pipe Works Ltd., Stockport

Bolton's Superheater & Pipe Works Ltd. exhibited a comprehensive range of their products, including Bolton-Grey ash-blowing equipment for flue cleaning which can be operated whilst the boiler is at work. Two models are available, Model A which is applied to the furnace tubes only, and Model B which incorporates a sequence of steam jets throughout the whole flue system. In this case the ash is carried right out to a settling chamber from where it can be discharged. Bolton-Grey superheaters, which may be used in conjunction with all types of boilers, were also shown, and other items included the company's steam separators, expansion joints for Lancashire boilers which prevent high-temperature gases by-passing between downtake and side flues, and hydraulic control valves for water or oil services, including remote control by air and solenoid operation.

British Boiler Accessories Ltd., 62/3, Fenchurch Street, London, E.C.3

An exhibit introduced by this company for the first time was the B.B.A. Helitube heat-exchanger—a unit developed by the company and their Continental associates, and one which has proved suitable for a wide range of industrial applications. This heat-exchanger is of compact and serviceable design, and offers many unique advantages. An illuminated panel on the stand described the company's method of steam accumulation. Also featured were examples of the B.B.A. external charging device fitted to a standby Lancashire boiler.

The British Boiler Accessories Ltd. external charging device fitted to a Lancashire boiler.

The British Rototherm Co. Ltd., Merton Abbey, London, S.W.9

Dial thermometers, recorders and controllers were exhibited by British Rototherm. For bi-metal actuation there were a variety of temperature ranges, presentations, stem lengths and diameters for most boiler house, engine-room and associated applications, together with max./min. and control/alarm thermometers, and special designs for other industrial purposes. Mercury-in-steel thermometers included distant reading and rigid stem models, and max./min. and control/alarm thermometers. A wide range of distant reading and rigid stem vapour pressure thermometers was also shown, together with mercury-in-steel temperature recorders of the single and dual pen types, and wet and dry bulb recorders and portable recorders.

British Steam Specialties Ltd., Fleet Street, Leicester

This company showed a comprehensive range of gunmetal and cast-iron flanged and screwed valves. Bourdon-type pressure gauges, bimetallic strip-actuated thermometers, Vee-Reg globe-valves in bronze and steel (size range ¼-in. to 10-in.) for use on high- and low-pressure saturated and superheated steam, and for high-pressure hot water. Also shown was the Vee-Reg/Rotork electrically-operated valve for remote control, and a full range of Velan steam traps for pressures up to 2,500 lb./sq. in. and temperatures up to 1,100 deg. F., including the Velan Monofloat steam trap, designed for discharging condensate, and a range of Velan forged-steel and stainless-steel bonnetless stop and gate valves for pressures up to 5,400 lb./sq. in. and temperatures up to 1,400 deg. F. Sizes ½ in. to 3 in. (2½ in. maximum for 5,400 lb. sq. in.).

The British Vacuum Cleaner & Engineering Co. Ltd., Goblin Works, Leatherhead, Surrey

This company exhibited representative examples from their wide range of portable industrial cleaners, and fixed vacuum cleaning installations. The company specialises in the manufacture of pneumatic flue-cleaning equipment which removes hot ash, by a method which has proved to be one which maintains the highest boiler efficiency and reduces manual labour to a minimum. B.V.C. machines are also available for extraction, reclamation or removal of dust, light materials or even liquids. A wide range of tools are available to cover most cleaning problems, but the company can also supply tools to meet any special condition.

Brockhouse Heater Co. Ltd., 25, Hanover Square, London, W.1

The Brockhouse oil burners exhibited covered heating requirements for the small domestic to the large industrial user. The Modulating types range from the 2MY190, with a rating of 10,000,000 B.Th.U./hr., to the 2M190, 5,000,000 B.Th.U./hr., and the M190, 3,500,000 B.Th.U./hr. The series F.A.P. 165 rating is 1,500,000 B.Th.U/hr., and F.A.P. 55/1, 650,000 B.Th.U./hr. Finally, the small burners, L.O. 600 and L.O. 400, are rated from 600,000 to 400,000 B.Th.U./hr.

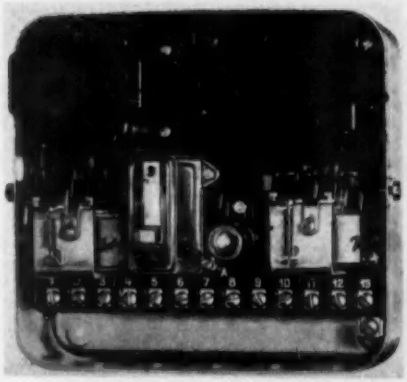
Cambridge Instrument Co. Ltd., 13, Grosvenor Place, London, S.W.1

The Cambridge Instrument Co. Ltd. showed exhibits from their wide range of proved fuel-efficiency instruments including indicators, recorders, etc., for use with all types of boiler plant. Among

the seclection shown were O_2 and CO_2 meters, thermometers, pyrometers and draught indicators. A full-size model of a boiler instrument panel was used to demonstrate the control of oil-fired or other boilers for space heating. It provides for smoke-density assessment. Other Cambridge instruments shown included boiler control instruments, chemical plant control instruments, CO_2 indicators, combustion recorders, draught-gauges, pressure regulators, recording thermometers, temperature regulators, etc.

(Left). A Cambridge 10-in. scale CO_2 indicator.

(Right). The Danfoss type CFS control box for oil-burners.



The Cape Asbestos Co. Ltd., 114 & 116, Park Street, London, W.1

Rocksil insulation material, manufactured by the Cape Asbestos Co. Ltd., is being fitted at the UKAEA experimental atomic station at Dounreay, and Caposite and Rocksil to the Berkeley nuclear power station being built for the CEGB by the AEI-John Thompson Nuclear Energy Co. Attention was drawn to the merits of these two well-known insulation materials, on the company's stand, and a special feature made of the new Rocksil rigid pipe sections which became available earlier this year. "Asbestolux," the asbestos insulation board made by a subsidiary, Cape Building Products Limited, was also displayed. This material meets both the fire protection and insulation requirements of the Thermal Insulation (Industrial Buildings) Act.

Cochran & Co., Annan, Ltd., 34, Victoria Street, London, S.W.1

On this stand was exhibited a Cochran vertical boiler which was coal-fired by a Prior stoker, a Cochran vertical boiler oil-fired by Clyde burners, a "Sinuflo" economic boiler, a Ruths steam storage accumulator, and a Cochran vertical composite oil-fired and exhaust-gas boiler for marine use. In addition, there was a display of photographs showing Cochran products and installations.

Colostat Combustion Systems Ltd., 5, Sidney Road, Stockwell, London, S.W.9

On this company's stand there were fully-automatic oil-burners suitable for both 200 sec. and light oils with special methods of control. A feature of the 200 sec. burner is the nozzle heater which ensures that oil of the right temperature is always available at the jet, even after shut off, for correct atomisation. Incorporated in the control circuit is a solenoid valve for complete and instantaneous stoppage of oil supply when the burner stops under thermostatic control. Also exhibited were hopper and bunker-feed models of the Colostat underfeed stoker. The controls incorporated in these machines, particularly the Colmatic modulator, enables bituminous fuels to be burnt in such a way as to comply with the Clean Air Act.

Combustions Limited, Cox Lane, Chessington, Surrey

Combustions Ltd. exhibited six burners from their range of Hero, Automestic and Rotamisor oil-firing systems. The Hero burners are of the high-speed power-driven rotary-cup type, capable of handling all available grades of fuel oil, and are adaptable to a diversity of firing control methods, including semi-automatic high/low step control, and full modulation, which can, according to individual installation requirements, be combined with fully-automatic on/off functions for maximum saving of labour in the boiler house. Three units were exhibited from the well-known Automestic range of fully-automatic gun-type, pressure-jet burners. All these burners have a new type of high efficiency combustion head, and in the instance of the "G" and "F" type preheating burners, for use with light fuel oil, an improved method of re-circulating preheated fuel to the nozzle during the starting cycle. The No. 4 Rotamisor burner and air director assembly was also exhibited.

Crosthwaite Furnaces & Scriven Machine Tools Ltd., 32, Victoria Street, London, S.W.1

Crosthwaite furnaces are used for all types of solid fuel and are particularly suitable for the burning of smokeless fuels. The "Crosthwaite" patent gravity-feed smokeless self-cleaning stoker fitted with infinitely variable speed drive and designed for installation on horizontal shell-type boilers and small water-tube boilers will burn a wide range of fuels efficiently without smoke emission and maintain maximum output. Also shown were mechanical stokers, self-cleaning grates and fan-air equipment suitable for shell-type and water-tube boilers; particularly suitable for fluctuating leads and quickly responsive to cope with peak loads. "Crosthwaite" patent portable coal-elevators were also exhibited.

Combustion Equipment Ltd., 61, Belsize Lane, London, N.W.3

This company showed examples of the Mark IV furnace baffle which they have developed in collaboration with B.U.C.R.A., and which is designed for application to the flues of Lancashire and Economic boilers. The baffle is composed of a number of refractory blocks which can be arranged in various ways to produce baffles for any furnace diameter. Other exhibits included examples of the Cory grit-arrester, and a new gas-tight damper.

Danfos Manufacturing Co., 13, Queensway, London, W.2

This company is well known in Britain and throughout the European continent as specialists in the design and manufacture of a comprehensive range of oil-burners and automatic oil-burner control equipment for modern heating plants, automatic and thermostatic controls for heating plants, air conditioning installations, etc. Exhibited were various examples of their comprehensive range of equipment. Specially displayed were the latest types of Danfoss controls, pumps, atomising nozzles and other equipment including thermostatic radiator valves, thermostatic expansion valves, solenoid valves, and electric motor control gear. Danfoss oil-burner atomising nozzles are available for the atomisation of oil in high-pressure oil burners. Exhibited for the first time was a fully-automatic control box for oil burners (type CFS) in which the use of a semi-conductor photo-resistor as the flame control has made it possible to eliminate the amplifier circuit. The photo-resistor is claimed to be more efficient than the photo-cell hitherto used, and the spectral sensitivity of the unit can be so adjusted, that the influence of heat radiation alone, say from furnace brickwork, will not cause the photo-relay of the control box to respond. These various factors, in conjunction with the fitting of sturdy relays with laminated iron cores, make the new type CFS unit a very robust control box with an accurate and reliable performance based on high sensitivity and quick response to the presence of the flame.

Danks of Netherton Ltd., P.O. Box No. 22, Netherton, Dudley, Worcs.

Danks of Netherton Ltd. exhibited one of their patented "Supapak" fully-automatic oil-fired boilers, fitted with a fully-modulating burner having a five-to-one turndown ratio. The "Supapak"

has the merit of being accessible on both the fire and water sides, with all the advantages of the wet and dry-back types, without the faults of some of these designs. The tube layout in the "Supapak" is based upon the setting introduced by this firm in 1934, when they produced their well-known patented "Super Economic" boiler, which has met with such success; but the "Supapak" has been specially designed to meet the demand for a boiler to handle fuel-oil and C.T.F. fuels. Units for capacities up to 17,500 lb./hr. are available.

The Darlington Group of Companies, 38, Great North Road, Newcastle upon Tyne, 2

The Darlington Group of Companies was represented by two of its member companies—The Chemical & Insulating Co. Ltd. and The Darlington Insulation Co. Ltd. The Chemical & Insulating Co. Ltd. processes dolomite limestone to produce magnesia chemicals and insulating materials which are used all over the world. The principal insulating materials are Darlington 85 per cent. Magnesia, Metadextramite and Dextramite, which are manufactured as pipe-sections, slabs, plastic and in other forms for different purposes. Darlington Paratherm Calcium Silicate, which has recently been introduced, is a relatively light and strong one-piece insulating material specially developed for the oil industry; it is assured of wide application in other industries as well on account of its wide temperature range and the ease of stocking and maintenance. The range of materials is completed by a series of finishing and armouring compounds and insulating cements. Samples of the insulating materials were displayed, and their effectiveness in reducing heat loss demonstrated by a pyrometer unit that could be operated by visitors to the stand. The Darlington Insulation Co. Ltd. is the main contracting member of the Group.

Drayton Regulator & Instrument Co. Ltd., Horton Road, West Drayton, Middlesex

The Drayton Regulator & Instrument Co. Ltd. demonstrated that the use of efficient steam trapping and correct control will save fuel. The demonstration consisted of a steam-coil-heated tank controlled at the boil by a self-operated VT controller, the coils being trapped by a Drayton/Armstrong steam trap. Provision was made to demonstrate the increase of steam consumption resultant on poor trapping and lack of control. Allied to this demonstration was a heat-exchanger utilising the sensible heat of the condensate, and controlled by a Drayton Dial Set 50 controller. Temperature recorders showed the condensate and tank temperatures. The company also demonstrated a range of air-operated controllers on a typical air-conditioning plant.

Elcontrol Ltd., Hitchin, Herts.

The Elcontrol exhibit concentrated on flame-failure and ignition programming control equipment for use with all types of gas and oil-fired burners. The FSM series units make use of an infra-red sensitive cell for flame detection, and this equipment is, in general, suitable for use with all types of burners. The FSP series are newly introduced units, making use of a standard photo-electric cell for flame detection and are suitable for use on luminous flames only. The FSD series are also photo-electric burner controllers evolved particularly for use with inexpensive burners using gas oil and of the type generally described as domestic oil burners. Both FSM and FSP ranges include models suitable for manually-controlled burners and also for burners under fully-automatic control. Elcontrol are now also specialising in supplying complete electronic control panels for individual users and representative items from this range were also shown.

Electroflo Meters Co. Ltd., Abbey Road, Park Royal, N.W.10

On the Electroflo Meters Co. Ltd. stand typical automatic boiler control systems for all types of boiler were demonstrated. These systems included the control and measurement of fluid flow, temperature and the rate of feed of solid fuel by means of flow meters, pneumatic hydraulic and electronic regulators and controllers as well as pyrometers and potentiometers. In the latter field, the miniature Electroflo electronic potentiometer (Series No. 198) may be modified to emit a pneumatic signal so introducing a combined electronic and pneumatic control arrangement. Emphasis was placed upon smoke density equipment, and it was pointed out that the company have been manufacturing a smoke density meter for a number of years, based upon the well-established photo-electric cell which is electrically related to the commonly accepted Ringelmann Chart.

The Elliott-Automation Group, Century Works, Lewisham, London, S.E.13

Four members of the Elliott-Automation Group of companies, Elliott Brothers (London) Ltd., James Gordon & Co. Ltd., Sauter Controls Ltd., and Panellit Ltd., exhibited examples from their extensive ranges of instrumentation and control equipment for all types of power plant, as well as for heating, ventilating, air-condition and refrigeration systems. The main exhibits by Elliott Brothers (London) Ltd. were two complete boiler control units in which standard Elliott and Bristol's instruments were used for indication, recording, and automatic control to maintain maximum efficiency for the load conditions at any time. The instruments included covered the measurement of oil, steam and water flows, temperatures, levels and pressures; measurement and control of draught; flue-gas analysis and overall heat-meter (B.Th.U.) equipment. James Gordon & Co. Ltd. were showing a wide slection of the components used in their well-known and very versatile pneumatic system of automatic boiler control, including their Type S-D modulating control for oil-fired boilers. Also displayed were a variety of Gordon control valves, including butterfly and needle types for pressure reduction, desuperheating, overflow and other functions; sandwich-type butterfly valves, and butterfly valves of a specially tight-shutting design. Sauter Controls Ltd. exhibited a selection from their range of valves for various functions, including motorised valves and damper drives. An interesting feature was a display of equivalent electrical and pneumatic control equipment for heating, ventilating, air-conditioning and refrigeration plants. The main exhibit by Panellit Ltd. was a typical data-reduction and efficiency-computing system for use with an oil-fired steam-raising plant.

E. Green & Son Ltd., Economiser Works, Wakefield

E. Green & Son Ltd. in addition to showing their economisers and air-heaters, introduced various new products. Of particular interest, in view of the Clean Air Act, is the Paraclone dust-collector, a working exhibit of which was shown. Visitors were able to observe its performance by feeding dust into the inlet and seeing it separated and returned to the collecting hopper. In addition, there was featured an S.K.D. collector which is the smallest dust-collector of a range designed to deal with industrial boilers and for other industrial uses. By the introduction of fans to their products made in England, E. Green & Son Ltd. can now offer an integrated unit of economiser, airheater, dust-collector and fans. Their associate company in U.S.A. have for many years supplied American industry with fans, and this experience is now offered to British users. A small induced-draught fan, one of a considerable range, which has been built for a recently obtained contract, was exhibited.

G.W.B. Furnaces Limited, P.O. Box No. 4, Dibdale Works, Dudley, Worcs.

G.W.B. Furnaces Ltd. exhibited two of their Powermaster packaged automatic oil-fired boilers, which are delivered to site with all necessary ancillary equipment such as fuel and water pumps, instrument panel, etc., mounted on a steel channel base. All boilers are fire-tested in the manufacturers' works before despatch, and all that requires to be done before starting up is for connections to be made to the electricity, water, fuel and steam lines. The Powermaster is either oil or gas fired, and so the problems and dirt associated with solid fuel are non-existent, and since the unit is automatic in operation, labour costs for attendance are negligible. The unit is completely smoke-free in operation. Efficiencies of over 80 per cent. are guaranteed, and fluctuating loads are easily catered for with a negligible drop in boiler pressure.

Hamworthy Engineering Ltd., Poole, Dorset

Among the main items of equipment exhibited on the Hamworthy stand was a forced-draught rotary oil burner designed specifically for the heavier grades of fuel oil, with manual, semi-automatic or fully-automatic modulating control. The

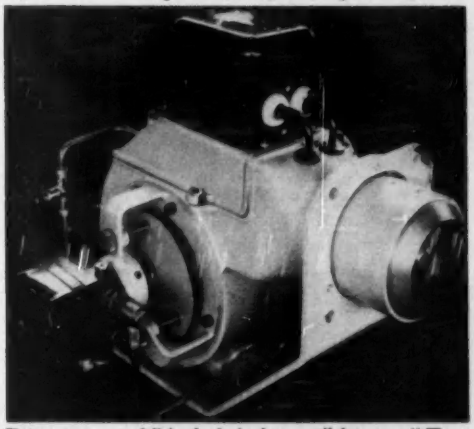
burner operates on the rotary cup principle of atomisation, with fuel being fed to the rotating cup through an oil reservoir which embodies duplex fuel pumps, a viscosity or proportioning valve to balance the supply of oil between the atomising cup and the return line dependent on load demand, and finally a pressure equalising piston which compensates for unbalanced pressure conditions in the return system. The viscosity valve, by proportioning the fuel between the atomising cup and the return line under conditions of automatic or hand control, permits a turn-down range of 3 : 1. Primary air for atomisation is supplied by an aluminium fan and precisely controlled by an air shutter over slots in the fan intake. Secondary air is admitted from a forced-draught fan of the axial-flow type which is mounted below the burner on a specially designed windbox casing. Other burner equipment included a low-density heater, gas ignition equipment and flame failure control equipment. Various sizes of burner are available for boiler outputs between 800,000 to 19,000,000 B.Th.U./hr.

Alfred Herbert Ltd., P.O. Box No. 30, Edgwick Works, Coventry

Featured on the stand of Alfred Herbert Ltd. was the Atritor dryer-pulveriser, for use with all types of boilers, rotary cement kilns, and various types of metallurgical furnaces. The Atritor, a small, smooth running machine capable of dealing with fuel of very high moisture contents, occupies little space. By attrition, it grinds, dries, and delivers coal to the burners in one operation. Component parts of the atritor are the feeder, metal separator, pulveriser and fan. Special attention has been paid, in design and manufacture, to the replacement of wearing parts so that maintenance can be carried out easily and speedily.

James Hodgkinson (Salford) Ltd. Brettenham House, Lancaster Place, Strand, London, W.C.2

By means of photographs, models, technical literature, etc., and by advisory information from technical representatives on the stand, full information concerning the full range of mechanical stokers and conveyors made by this well-known company was available. Actual stokers, some of which were working exhibits, were displayed on the stand of Bennis Combustion Ltd. (a subsidiary company in the Hodgkinson Group). The range of Hodginson stokers comprises the well-known "Low Ram" coking stoker—the latest model of which is the Mark III machine capable of dealing with all ranks of coal, and is quite unrestricted where the size of fuel is concerned (up to 2½-in. cube). The main feature of the "Low Ram" stoker is that the widest possible feeding mechanism has been embodied in the design to ensure an even firebed over the whole width of the grate. One of the most important features of the stoker is that under conditions of power failure, the machine can be hand-fed, using natural-draught without fear of damage to the grate. The Hodgkinson chain-grate stoker is designed and constructed to the highest standards, after a considerable period of practical research and experiment by Hodgkinsons, who are, of course, specialists in the mechanical firing of solid fuels. The Hodgkinson Meterfeed Underfeed Stoker was developed with the aim of producing a stoker which, whilst being of the simplest possible design, would nevertheless embody the controlled feed principle.



A new type "AR" oil-burner, manufactured by Hope's Heating & Engineering Ltd., and specially designed for the smaller boiler, air-heater or furnace.

W. C. Holmes & Co. Ltd., P.O. Box No. B.7, Turnbridge, Huddersfield

Exhibits on the stand of W. C. Holmes & Co. Ltd. included a 1,000 cu. ft./hr. catalytic sulphur removal plant, as an example of the type of unit which is designed to remove 70-80 per cent. of the organic sulphur contained in town gas. Also exhibited was the Holmes-Schneible multi-wash system, applicable to a wide range of dust collection and control problems involving liquid and solid particles. The multi-wash collector has an efficiency of the order of 99 per cent. for all particles above 3 to 4 microns. The Holmes-Rothemuhle multi-cell cyclone dust collector, designed to reduce the stack emissions from hand, stoker and pulverised fuel-fired boilers, and the Trion electronic air filter were also displayed. This latter equipment is essentially for applications where the total dust loading is substantially less than that occurring in heavy industrial plant, but which is sufficiently high to have deleterious effects. Finally, the exhibits included Holmes-Connersville positive air blowers, which are of simple design, having no moving vanes, valves, springs or other small parts to work loose, become noisy or wear out.

Honeywell Controls Ltd., Greenford, Middlesex

Controls for all stages in the production and distribution of heat were displayed by Honeywell Controls Ltd. Boiler and burner controls were included, together with an indicating furnace pressure controller, a multiple-point electronic temperature recorder, an electronic temperature indicator, and non-indicating temperature and pressure controllers. The latest electronic controls for combustion programme and safety applications were also displayed. Space heating control systems demonstrated how the delivery of heat can be controlled precisely—and with maximum economy. System components displayed included line and low-voltage thermostats, electronic control panels, and associated room, insertion, and outdoor thermostats.

Hope's Heating & Engineering Ltd., Smethwick, Birmingham

Hope's Heating & Engineering Ltd. exhibited their large oil-burner "Type C," their medium burner—"Type B," and their small burner—"Type A." Also displayed was a new oil-burner (type A.R.), specially designed for the smaller boiler, air-heater or furnace, where compactness of burner design is an important factor. The types A, B and C, are designed for a range of 65,000-2,750,000 B.Th.U./hr. The type A.R. burner, which was on show for the first time, has a range of 65,000-4,000,000 B.Th.U./hr. The design is robust and compact and is suitable for furnaces requiring flange-mounted burners. Also exhibited was the latest model of Hope's draught stabilisers which have proved so successful in reducing operating costs.

Hopkinsons Limited, Huddersfield

Hopkinsons Ltd. displayed a varied selection of their valves, boiler mountings and associated equipment covering a very wide application to industry and power generation. High-pressure power station valves were represented by an electrically-operated 9-in. Hopkinson-Ferranti valve with control cubicle, three full-lift safety valves, including the torsion-bar type, and a group of small forged steel valves for various duties, including units for 2,000 lb./sq. in. steam pressure. Water level indicators in the display comprised two types of bi-colour indicators, a remote bi-colour water-level indicator and a demonstration unit of the firm's water-level television system. The soot blowing equipment shown comprised two electrically-operated blowers, with control cubicle, master valve and drain valve to demonstrate the system of sequence control, and a hand-operated blower for marine installations. Other items relating to power station equipment were a critical-pressure gauge, two valve lapping machines and thermal pump leak-off

equipment. Industrial valves for low pressures were represented by a typical safety valve, "Nolos" steam trap, relief valves, various types of bronze stop valves and non-return valves, blow-off valves and a pillar water gauge mounting. The display also included one of the company's centrifugal separators.

Hubbard Combustion Ltd., 30 Fife Road, Kingston-on-Thames

This firm exhibited a Wallsend-Hubbard oil-firing front suitable for application to shell-type boilers and arranged for modulating/on-off control. This equipment is designed to provide efficient smokeless combustion. Wallsend-Hubbard oil-burning equipment can be provided arranged for hand, semi-automatic, or fully-automatic modulating/on-off control. Whatever method of control is selected, the air and oil supplies are regulated in proportion to give the correct air/oil ratio whether the boilers are operating at maximum duty or under light load conditions, thus assuring maximum efficiency together with clean smokeless combustion.

International Combustion Ltd., 19, Woburn Place, London, W.C.1

The exhibits on this stand covered a comprehensive range of firing equipment; stokers, pulverised-fuel and oil-firing for industry and power station installations. The main feature was a complete tilting corner burner unit for one of the International Combustion Ltd. 200-MW reheat boilers at High Marnham power station. This unit has oil lighting burners of the tip shut-off recirculating retractable type, rated at 1,430 lb./hr. Another oil lighting-up burner displayed was designed for large pulverised-fuel fired power station boilers and has independent air supply and remote sequence control. A spill burner was also shown with tip shut-off and wide-range operation for high oil pressure and moderate air pressures. Mechanical stokers were represented by a working scale model of the "L"-type travelling grate. This machine finds wide application in industry, and is available with grate areas up to 1,000 sq. ft.

Ivor Power Specialty Co. Ltd., 29, Woburn Place, London, W.C.1

Sootblowing equipment for cleaning shell-type and water-tube boilers was exhibited by Ivor Power Specialty Co. The Ivor traversing-jet sootblower is mainly used for vertical, economic and smoke-tube boilers. It is simple to operate by means of chain or extended hand operating gear. Considerable efficiency is gained by being able to clean the tubes whilst the boiler is on load, and labour saving is a further advantage. The Ivor industrial gun-type sootblower is suitable for cleaning the walls of screen tubes of water-tube boilers. Typical illustrations of Ivor suspended brick arches were also displayed.

Kelvin & Hughes (Industrial) Ltd., 2, Caxton Street, London, S.W.1

On the stand of Kelvin & Hughes (Industrial) Ltd., was the first completely automatic boiler control equipment which has been specifically designed for shell-type boilers and incorporates steam pressure (or high-pressure hot water temperature) control and combustion regulation. This low cost equipment for the precise automatic maintenance of efficient combustion conditions, includes CO_2, temperature and smoke recorders, loss meters and a multi-point temperature indicator. A master control-panel, designed for mounting remote from the boilers, contains a master pressure controller and a steam/flow pressure recorder. A comprehensive steam pressure control system for oil-fired boilers which incorporates a specially developed photo-transistor control circuit was also displayed. The controller is of the proportional-action type which regulates both the oil and air supplies via an electric motor; thereby maintaining constant steam pressure and optimum fuel/air ratios under varying load conditions. In addition the exhibit included comprehensive instrumentation for small and medium sized boilerhouses, gas analysis, smoke detection and the measurement of temperature, flow and draught.

(Above). The main control cubicle of the Lancashire Dynamo smoke densitometer and alarm (series SME 2).

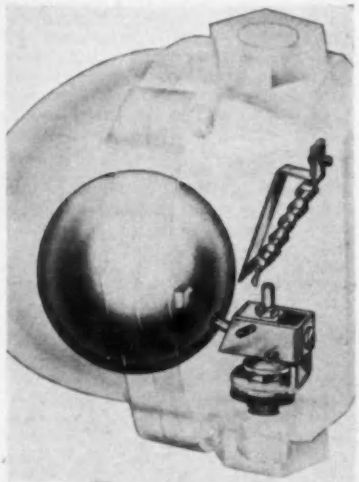
(Right). The new float-trap manufactured by Midland Industries Ltd.

Lancashire Dynamo Electronic Products Ltd., Rugeley, Staffs.

A wide range of smoke density and alarm equipment was shown by this company, including a free-standing cubicle-mounted version of the standard installation incorporating a chart recorder and alarm. This new addition to the range of accessories represents a trend to the "packaging" of these equipments, thus reducing installation problems and cost to the minimum. Space was also given to a working model of the equipment showing the use of many of the useful fitments which are available. The company also exhibited a range of transistorised capacity-operated level control equipment. A unit in this range which is of particular interest to the fuel industry, was specially designed for use in the storage bunker of electrostatic precipitators to prevent overfilling and short-circuiting of the charged precipitator grids. The probe assembly was designed to operate at high temperatures (up to 400 deg. F.) and has considerable length in order to ensure a safe level of material even towards the centre of the storage bunker. The basic standard equipment in the range of level control units has facilities for several alternative probe assemblies, one of which is of extremely rugged construction suitable for use in coal or coke storage hoppers. Amongst other smaller exhibits were examples of flame-failure and other photo-electric equipment for switching and control purposes.

The Leeds Meter Co. Ltd., Tower Works, Armley, Leeds 12

The stand of this company featured integrating meters and recording instruments, which included the Leeds rotary, displacement, and Helix meters, for the measurement of boiler feedwater, industrial liquids, and process control applications. Some of these instruments were sectioned and "exploded" for illustrative purposes. Also shown was the Leeds chart recorder suitable for incorporation on an instrument panel, and operated by electrical transmission from a meter placed in a remote position.



Marshall Sons & Co. Ltd., Gainsborough, Lincs.

Marshall Sons and Co. Ltd., exhibited a Cleaver-Brooks "Monitor" fire-tube packaged boiler, a four-pass horizontal unit with 5 sq. ft. of heating surface per rated boiler horsepower, mounted on a heavy steel frame with integral forced-draught blower and burner controls. Both front and rear heads are completely sealed and fastened with heavy duty cap screws. Rear refractory and insulation are contained in the formed rear head which swings open for inspection. Flue and all tubes are accessible for inspection or cleaning when the heads are swung open. The boiler insulation jacket consists of a fibre glass

blanket under a sectional preformed sheet metal lagging. A full complement of high-class steam and water mountings are supplied with each boiler, together with fully-approved control equipment, and they are fitted with oil burners of the pressure atomising multi-nozzle type with automatic two-stage ignition, specially designed for operation with light oil. The burner operates on the "on-off" principle and in all but smallest boilers the main burner nozzle is lit from the pilot nozzle after a timed interval. Combustion control, with a timer motor, establishes a time schedule for each phase of burner operation. The burner assembly is mounted in the front head, which may be swung open for inspection and maintenance. The company manufacture the complete range of Cleaver-Brooks steam and water generators, with capacities up to 20,000 lb./hr.

Metropolitan Engineering Co. Ltd., 47, Whitechapel High Street, London, E.1

The Metropolitan Engineering Co. Ltd. and their associates exhibited advanced techniques of draught control and boiler isolation. With normal industrial boilers Metro-Flex control ensures that fuel (oil or coal) is always consumed at an efficient rate. The gas-tight seal effected when the units close enables the boiler itself to be used in another capacity altogether—as a thermal storage unit—when the steam demand ceases. The Metro-Flex system is also applied to the largest water-tube boilers, and the equipment is being fitted at one of the nuclear power stations now under construction. Originally produced in Germany, this system of gas-tight sealing has been developed and perfected in this country over the past 30 years.

Midland Industries Ltd., Heath Town Works, Deans Road, Wolverhampton

Midland Industries Limited, makers of the well-known MIL range of bi-metallic thermostatic steam traps, pressure-reducing valves, steam and high-pressure hot water valves and other accessories, showed examples of all their products, many of which were exhibited under actual working conditions. A new introduction was a very compact and robust float trap. In this, particular attention has been paid to the float mechanism, and to ensure trouble free service, the float leverage does not act through pivots or hinge at any particular point, but is made to roll on a convex surface—the valve block merely being constrained to travel in only one plane. An inherent characteristic of this ingenious design is that the rate of valve opening increases with an increase in the flow of condensate and vice versa, thus providing a constant discharge when operating conditions are fluctuating. The venting of air is ensured by the fitting of a bi-metallic element which under change of temperature will operate the main valve in opposition to the action of the float; this element together with the general robust construction of all components makes the trap ideal for use in the most arduous conditions and where superheated steam is present.

The Morgan Crucible Co. Ltd., Battersea Church Road, London, S.W.11

Although the continued trend in furnace operation is towards higher output, higher temperature and more severe operating conditions, unless refractories used keep in step with these demands, heavy maintenance costs and shut downs may well cancel out the advantages gained by extra efficiency and higher output. Moreover, a furnace with high maintenance costs usually has high fuel costs also, for it does much of its work with the refractories in a bad condition. The solution to this dilemma is obviously the use of refractories which will stand up to these higher demands, and in fact, it is the rapid improvement in refractories that has made modern furnace design possible. Morgan Refractories Ltd. have been able to develop a range of mouldable and castable refractories that can be fired *in situ* and yet have a performance comparable to that of the best super duty pre-fired refractories. This is known as the Tri-mor range of castable and mouldable refractories, numerous examples of which were exhibited. Refractories for special purposes were shown in four sections, as were a selection of ancillary "Triangle" recrystallised alumina ware for use in laboratories at high temperatures up to 1,950 deg. C.

Newalls Insulation Co. Ltd., Washington, Co. Durham

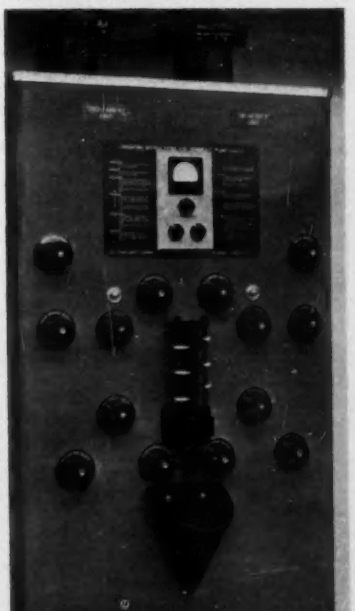
This company (a member of the Turner & Newall organisation) exhibited materials for heat and cold insulation, also for noise reduction and acoustic treatment, including Newalls 85 per cent. magnesia, asbestos, Newtherm calcium silicate, Newtempheit, E.H.T. (extra high temperature) and Nicosil. Other products included Nonpareil and Newparex insulating bricks; sprayed "Limpet" asbestos; cork, polystyrene, glass fibre, foam glass mineral wool and rock wool; and Newalls Paxtiles, Paxboard and Paxfelt. Examples of different finishes, such as plain aluminium, corrugated aluminium, galvanised and planished steel, plaster, cement, canvas, etc., which may be used on both heat and cold insulation, were also displayed.

Newton Chambers & Co. Ltd., Thorncliffe, nr. Sheffield

The Redfyre Emma boiler, claimed to be one of the most efficient coke-fired boilers in the world, was shown by Newton Chambers & Co. Ltd. This boiler, which was introduced to this country earlier this year, has been proved on the Continent for several years (where it is made by Bronswerk N.V. of Holland)—and has been tested and approved by the British Gas Council. Designed for central heating and hot water supplies in large buildings, the boiler is available in many sizes from 250,000 B.Th.U./hr. to 8,000,000 B.Th.U./hr. and can be installed singly or in multiple units. Another new product displayed was the Inka radiant type pre-heater, now manufactured in this country by Newton Chambers by arrangement with Industrikemiska Aktiebolaget of Stockholm. Designed for air or gas pre-heating up to 850 deg. C. it has considerably extended the upper temperature range for which Newton Chambers are now able to offer heat exchange equipment. Where fuel economy is essential, the combination of an Inka and a Newton needle unit (which was also displayed) enables the highest thermal efficiencies to be obtained. The temperature of the waste gases leaving the Inka preheater is sufficiently high for use on the conventional Newton needle unit. Another Redfyre oil-fired product on show was the Redfyre industrial space heater (capacity 8,000 to 16,000 cu. ft.).

Nu-way Heating Plants Ltd., Droitwich

This firm's display included examples of the Nu-way XL, ZL and ZH ranges of fully-automatic burners for light and medium grade fuel oil. New models shown included type ZL.6 and ZL.10 fully-automatic light-oil burners, with high efficiency combustion head and quickly detachable electrodes and nozzle assembly for easy maintenance by non-technical personnel. Also on show were the new models ZH.12.H/L and ZH.20.-H/L fully-automatic medium-oil burners with high/low/off control; a complete range of Rotavac industrial oil burners, and, displayed for the first time, the Rotavac PRN range of single lever proportioning oil burners, which offer complete control of the furnace atmosphere throughout their turndown range, which is approximately 7 : 1 on heavy fuel oil. This advanced design of burner is fitted with a flame shape regulator, and has a quickly detachable inner assembly for ease of maintenance. These units can be coupled to any standard form of control actuator.



Control panel for a Permutit type C.T.P., "Deminrolit" plant.

The Permutit Co. Ltd., Permutit House, Gunnersbury Avenue, London, W.4

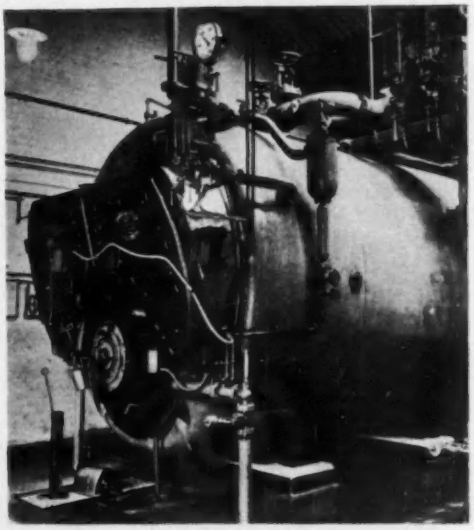
Correct feedwater treatment is, of course, highly essential for the efficient operation of boilers, as the presence of scale in boilers and hot water systems wastes fuel and incurs expensive replacement and maintenance costs. The Permutit Company Limited design and construct a complete range of water treatment plant for providing perfect feed water. Representative types of Permutit plant were exhibited, including fully-automatic base-exchange water-softening plant and "Deminrolit" ion exchange water demineralising plant. Also displayed, were other types of Permutit water-treatment plant for providing boiler feed and process water treatment; also control equipment which enables water-treatment plant to be controlled automatically.

Prat-Daniel (Stanmore) Ltd., Whitecroft, Nailsworth, Stroud, Glos.

This stand carried a joint display with the firms associate company—British Boiler Accessories. The Prat-Daniel exhibits comprised examples of low-resistance dust-collectors, including an actual unit to suit a 15-in. dia. steel boiler stack, and showing details of internal construction and principle of operation. There was also a model of a low-resistance collector fitted with a spark trap for use when firing wood-waste or other miscellaneous fuels, a "Bahco" wet cyclone, operating in conjunction with a grinding machine, and in addition, a perspex model to illustrate the principle of operation of this unit. A model of the "Turbo-collector," a combined induced-draught fan and grit-arrestor, was also shown. The Turbocollector is particularly suitable for application to modern shell boiler plant. Other exhibits were models of a wet type spark and grit-collection system for cupolas, and a model of a high efficiency tubular dust-collector. *British Boiler Accessories Ltd.* had exhibits featuring a complete range of their fuel saving equipment, viz., an illuminated panel describing B.B.A. Steam Accumulator System; the B.B.A. Dejector (boiler water softener and sludge extractor) for continuous removal of sludge from Lancashire and smoke tube type boilers, also for introducing suitable chemicals into the boilers; and the new B.B.A. "Helitube" heat-exchanger.

Paterson Engineering Co. Ltd., 129, Kingsway, London, W.C.2

The Paterson Engineering Co. Ltd., specialists in dealing with all problems connected with water supply, confined its exhibits to equipment appropriate to fuel efficiency. These included the Paterson Chloronome which prevents slime and algal growths in cooling systems. It is the pioneer of gas chlorinators using non-corrodible plastics and alloys. Where supplies of gaseous chlorine are not easily available, the Paterson Clorocel may be used. This is an apparatus for generating chlorine in the form of electrolytic sodium hypochlorite with the maximum activity for immediate use. For the treatment of feedwater for high-pressure boilers, ion-exchange or de-ionisation is now an established process. Small units illustrating the Paterson Solobed system were exhibited; this is the modern system for producing the equal of multi-distilled water without heat. Models of typical sand filters were exhibited, together with a small Stellar filter.



A Ruston & Hornsby horizontal "Thermax" boiler. This particular unit is installed in the Perivale, Middlesex, factory of Ponds Extract Ltd., and the illustration shows the small amount of brickwork required for a boiler of this type, and the relatively small space occupied by such units.

Prior Stokers Ltd., Prior Works, 1-3, Brandon Road, York Way, London, N.7

These exhibits included Prior bunker-flow and hopper-type stokers suitable for application to various types of boilers, furnaces and kilns, and which ensure smokeless combustion, greater efficiency, and effect considerable saving in costs. Pressure-jet fully-automatic oil-burners for use with light or 200 sec. oil, which are suitable for hot water and steam boilers and furnaces, and models of oil burners including the new Minor oil-burner which has a range of 50,000/125,000 B.Th.U./hr. Also shown was a Zephair "Major" oil-fired air-heater of 800,000 B.Th.U. capacity for use with 200 sec. oil, and a Zephair "Minor" stoker-fired air-heater of a capacity of 250,000 B.Th.U. which provide thoroughly efficient economic heating for all industrial purposes.

Radiovisor Parent Ltd., Stanhope Works, High Path, London, S.W.19

An entirely new series of units were to be seen in operation on the stand of Radiovisor Parent Ltd. A series of fully-automatic Flamestat units have been produced for operation on gas and oil burners incorporating features which cater for every contingency and are flexible in sequence control adjustment. The FF.56-SC is used for oil burners, the FR.56-SC for gas burners and the FU.56-SC for combination burners. The programme control section of this series of units may be supplied separately to give automatic burner control using existing flame failure protection equipment. Smoke density indicating and alarm control equipment, type RV.2, and the simpler smoke alarm equipment, type SA.56, were demonstrated, together with various recorders, and photo-electric and electronic level controls which have been applied to feedwater, ash disposal and fuel supply control systems were displayed. A new device exhibited, the Radiovisor Motoload relay, will be of direct interest to engineers requiring a sensitive control or indication of load conditions on fuel and ash conveying and elevating systems.

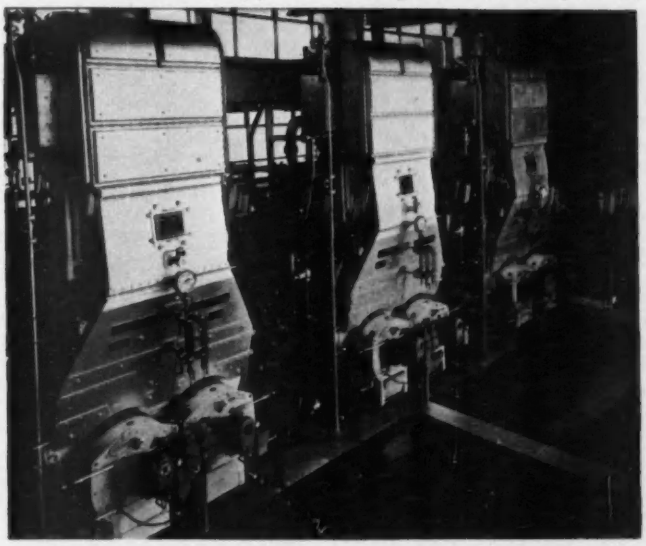
Riley (IC) Products Ltd., Nineteen Woburn Place, London, W.C.1

This company, one of the International Combustion Group, displayed representative machines from a wide range of combustion equipment. The Riley type "T" chain-grate stoker displayed will burn a wide range of coals and is suitable for Lancashire type boilers. The machine was shown complete with a mechanical ash removal system. One Riley Underfeed stoker was shown, the Direkto stoker, designed to convey coal direct from store to boiler. This machine is available in a wide range of sizes and is suitable for sectional, vertical and water-tube boilers. Oil burners displayed include the "F" burner designed to burn residual oils up to 950 secs., with the features of high oil and draught pressures and high CO_2. The "HL" burner is of entirely novel design and has a high and low burner for heavy oils. It has exceptionally high efficiency at high and low firing rates. Also on the stand were other Riley Underfeed stokers and oil burner equipment, and the company's oil-fired air heater.

Ruston & Hornsby Ltd., Lincoln

A complete horizontal "Thermax" three-pass wet back boiler was shown on the Ruston & Hornsby Ltd. stand, together with a well-planned photographic display illustrating a cross section of installations, ranging from hospitals to swimming baths, in which the

"Thermax" boiler has been employed. The horizontal "Thermax" boiler is made in several sizes from 6-ft. dia., with evaporations of 2,000 lb./hr., to 12-ft. 6-in. dia., with evaporations of 17,500 lb./hr. In addition to its efficiency, comparatively small dimensions and requiring negligible brickwork, the "Thermax" boiler also offers the advantages of speedy installation and reduced maintenance costs. Over 3,000 Ruston "Thermax" boilers have been manufactured during the last thirty years.



Cast-iron "H" tube economisers, as manufactured by Senior Economisers Ltd., and mounted on a shell boiler of the Economic type.

Senior Economisers Limited, 11, Southampton Row, London, W.C.1

Senior Economisers Ltd. had for their main exhibit a full-size cast-iron "H" tube economiser mounted on a shell-type boiler of the Economic type, the economiser and induced-draught fan being supported on brackets welded to the boiler shell. This arrangement is particularly attractive as it enables the floor space around the boiler front to be kept clear, and avoids any extra obstruction from the firing aisle. The actual economiser is a smaller version of the original "H" tube design with the familiar straight gas-passages, enabling low gas-outlet temperatures to be achieved without risk of corrosion or fouling. For higher pressures, the Senior welded design was displayed. This is constructed of steel tubes protected by cast-iron sleeves to form the extended surface. Straight gas-passages are again a feature of this design, and in consequence, comparatively low temperature feed water and low gas-outlet temperatures are possible without risk of corrosion. The Marine economiser, now well established in oil tanker installations was also displayed. This design is similar to that of the Senior welded economiser, except for the end box assembly and other minor details, which have been adapted to suit the particular requirements of marine plant.

Spirax-Sarco Ltd., Cheltenham, Glos.

A new product exhibited by Spirax-Sarco Ltd. was a thermodynamic steam trap. This is manufactured entirely from stainless-steel, and is designed to operate with temperatures up to 550 deg. F. and, without adjustment, pressures from 10 to 350 lb./sq. in. Further features of the new unit are that it incorporates a stainless-steel strainer; discharges condensate when present; shuts tight on "on load"; is unaffected by superheat, waterhammer, vibration, corrosive condensate and freezing; has no condensate seal or prime; and can be fitted either horizontally or vertically. In addition the company exhibited their well-known ranges of steam and compressed air traps, air vents, pumps, pipe strainers, sight glasses and flash vessels.

An example of the Spirax-Sarco new thermodynamic steam trap, designed to operate with temperatures up to 550 deg. F.

Steam Storage Co. Ltd., 20a, Lower Basinghall Street, Leeds, 1

This firm's exhibit afforded visitors to the stand an opportunity of seeing a complete steam accumulator in actual operation and its ability to transform a continuous input at low charging rate into short peak outputs of many times the input rate. A vertical steam accumulator was charged up to 150 lb./sq. in., and discharged through a reducing valve into an open dye vat at rates that can exceed 1,000 lb./hr. Typical charts, flow diagrams and photographs showed how these physical principles are employed to solve problems of fluctuating supply and demand in many industries and processes. Additional applications to problems of feedwater storage, process hot-water and high-pressure hot water systems were illustrated by means of photographs and diagrams.

J. Stone & Co. (Deptford) Ltd., Deptford, London, S.E.14

This company displayed Stone-Vapor steam generators which are oil-fired, compact, forced-circulation water-tube boilers providing an automatically modulating output in single or multiple installations. Fully self-contained and easy to install, each of the range of models available is about one-quarter the size and one-fifth the weight of conventional boilers of the same rating. There is no waste of fuel or water, for due to their quick-steaming characteristic, Stone-Vapor steam generators produce steam only when it is required. Other important advantages possessed by these packaged steam generators include :—installation without break in production, steam in 2 min. from a cold start, smoke-free combustion, the ability to cope with widely fluctuating loads in winter and summer, simple operation and maintenance, and constant high efficiency at all rates of evaporation. Stone-Vapour steam generators conform to the strictest insurance requirements, and have been proved in service in over 10,000 installations. The units are made under licence of the Vapor International Corporation Limited, U.S.A.

Sunrod Limited, Cray Avenue, St. Mary Cray, Kent

This firm had on display for the first time one of the Sunrod CP series vertical steam packaged boilers. The range covered by these units is 250 lb. to 6,600 lb. of steam per hour. These packaged boilers are very compact, and all equipment is mounted on a common base-plate. The operating efficiency is in excess of 80 per cent. on full load, and the boilers are built under the survey of a member of the Associated Offices Technical Committee. Also appearing for the first time was the Sunrod combined steam/electric and combined hot water/electric fuel-oil heaters which are also available as tank outflow heaters. An example from the Sunrod range of waste-heat recovery units for use with boilers up to 2,000,000 B.Th.U./hr. was also shown, together with economisers and various types of heat-exchangers.

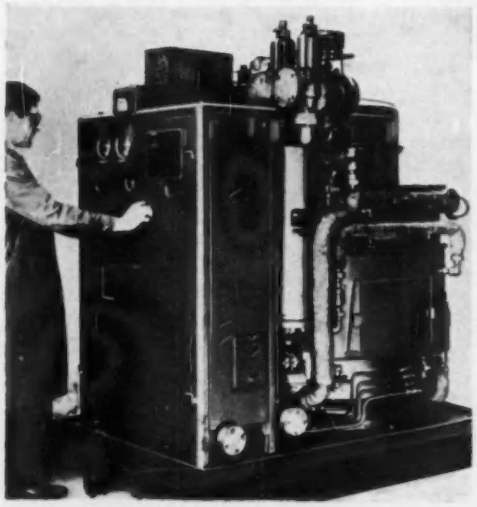
Teddington Industrial Equipment Ltd., Sunbury-on-Thames, Middlesex

Featuring a number of entirely new products, which are being introduced for the 1958 heating season, the Teddington stand displayed a comprehensive

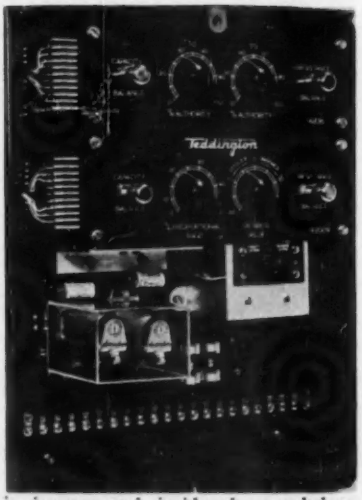
range of automatic control equipment for every type of heating and air-conditioning plant. New Teddington products included the "Transmatic" electronic control system; a new and improved photo-electric version of the Spediflam II oil-burner watcher; a new boiler thermostat available in clamp-on and insertion form; a new solenoid valve for high viscosity fuel oils, and a new furnace draught regulator. The "Transmatic" is the first British air-conditioning control system to make use of printed circuitry and a transistorised amplifier, two outstanding features which add to the well-known advantages of electronic control, the further advantages of simplicity, greater stability, easier installation, smaller size and reduced cost. The new boilerstat is designed primarily for central-heating boilers and is available in two forms—for clamping on to the boiler riser, or for insertion fitting.

Thermal Efficiency Ltd., 125, High Holborn, London, W.C.1

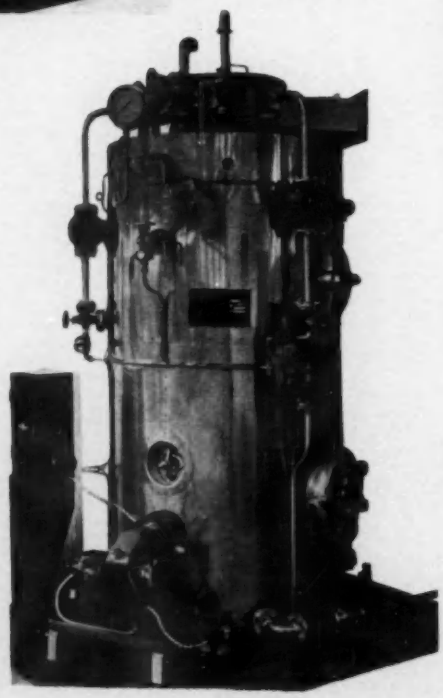
The most important exhibit on this stand was a full-size, cut-away section, depicting the firm's composite tube metallic forced-convection recuperator. This recuperator is of the tubular type, having high heat-resisting tubes with a finned heating surface. The construction of the composite tube ends, whereby a flexible steel collar is cast into the ends of the tubes, gives positive tightness on both air and waste-gas sides, and also takes care of the differential movement of the tubes under working conditions. This recuperator is capable of pre-heating air to 750 deg. C. Other items exhibited included a metallic unit radiation recuperator which is one of a series of nominal size for working on the smaller industrial types of furnaces and capable of preheating air to 500 deg. C. when working with a maximum waste gas temperature of 1,500 deg. C.



(Top). *An example from the range of Stone-Vapor steam generators manufactured by J. Stone & Co. (Deptford) Ltd., under licence of the Vapor International Corporation Ltd., of America.*



(Right). *Interior of the "Transmatic" control panel, containing three-stage transistorised amplifier, bridge boards and output relays built on a printed circuit.*

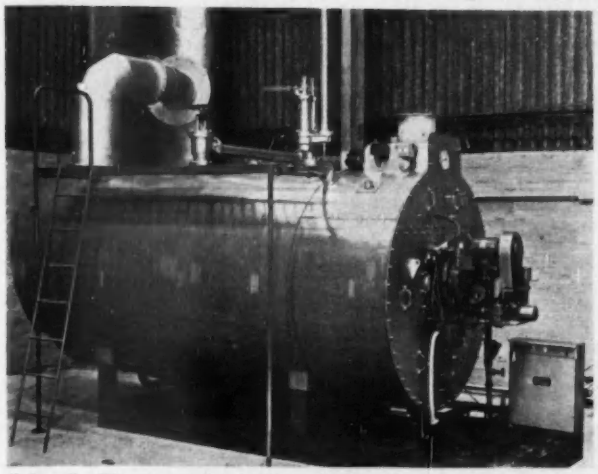


(Right). *The Sunrod CP02 packaged steam boiler, fitted with a Brockhouse LO.600 pressure-jet oil burner. This particular unit from the C.P. series has an evaporative capacity of 550 lb./hr.*

John Thompson Ltd., Wolverhampton

New products on the stand of the John Thompson Group included the Multipac boiler, an entirely new design of a high efficiency package boiler. A feature of this unit is the built-in wet back combustion chamber, designed to provide adequate volume, while also giving a very high degree of flexibility and entirely eliminating the necessity for refractory linings. The required volume is obtained by using a dished-end design for the wet back combustion chamber; this also reduces the number of stay bolts, further support being given by the cleaning door and soot blower housings. The boiler also has the additional advantages of having two passes of fire tubes arranged below the flue, with clear water space above as in a Super Economic boiler, and has independent tube-plates. The forced-draught fan is situated on top of the front smokebox and the ducting to the burner is incorporated inside the smokebox. This has the additional advantage that the intake to the fan is above the boiler and not at floor level. The Multipac is supplied complete with forced-draught fan, feed pump and a fully-automatic, fully-modulating rotary-cup oil burner. The burner is capable of burning all types of fuel oil up to and including 3,500 sec. Redwood No. 1, without the addition of a pumping and heating set. There are eleven sizes of Multipac units ranging from 2,500 to 10,500 lb./hr. evaporation. Also exhibited for the first time was a sectionalised model of one of the range of water-tube package boilers developed by John Thompson. The model indicates the compact two-drum design of this unit which is available in a range of sizes from 12,500 to 32,000 lb./hr., for working pressures up to 300 lb./sq. in. Units are delivered ready steam-tested, complete with auxiliaries, except feed pump and automatic control equipment which are supplied as optional extras. A superheater can also be supplied if required. The oil burner burns all fuel oils up to 3,500 sec. Redwood No. 1. The well-known

John Thompson chain grate stoker was exhibited with a new form of ash extractor. This extractor is operated by a vibrator unit as used in the Owl vibratory conveyor and elevator. There were also displays relating to water treatment plant by John Thompson-Kennicott Ltd., and pipework systems by John Thompson Pipework Ltd.



A model from the new "Multipac" range of boilers, manufactured by John Thompson Ltd., and available with evaporative capacities of from 2,500 to 10,500 lb./hr.

John I. Thornycroft & Co. Ltd., Thornycroft House, Smith Square, London, S.W.1

John I. Thornycroft & Co. Ltd. exhibited a specially mounted oil fuel burner which enabled a detailed demonstration of its working to be given. In this type of burner, which is capable of an output range of from 150 to 2,000 lb./hr., the fuel is sprayed into the boiler furnace at a controllable pressure and temperature, the proper mixture of air and fuel being obtained by the use of highly efficient atomisers and air registers. Its robust construction ensures long and reliable service and it combines simple and efficient operation with maximum safety. Another exhibit was a high-pressure pumping and heating unit of the simplex pattern which incorporates a completely new design of oil fuel heating of the vertical finned tube type. This unit has an output of 4,100 lb./hr. of oil fuel at a discharge pressure of 450 lb./sq. in., and has been especially designed for use with high-pressure hot water as the heating medium. The fuel pump is of the infinitely variable output pattern.

Ronald Trist & Co. Ltd., Bath Road, Slough, Bucks.

On this stand the Electricon smoke alarm, type A.S.B., was exhibited as a working model. Of simple and robust construction, this instrument gives warning that the smoke emitting from a chimney has exceeded a pre-determined maximum permissible limit. It is particularly suitable for the small boiler plant where excessive smoke emission must be prevented. For the larger installation where present day fuel costs demand continuous efficient combustion, highly accurate and sensitive indication of variations in the density of smoke being emitted can be obtained by using the more comprehensive Electricon smoke density indicator type C.S.B. A range of Mobrey magnetic level switches constructed in various materials were exhibited. Models are available for use in almost any liquid and with pressures up to 3,000 lb./sq. in. A simple and convincing demonstration unit was shown, having two level switches mounted through the side of a transparent tank containing water showing the consistent accuracy in operation of the equipment. There was also a working demonstration of the new Mobrey modulating level controller, designed primarily for fitting to steam boilers for the purpose of maintaining the water-

The new Mobrey dual control shortly to be made available by Ronald Trist & Co. Ltd., for working pressures up to 250 lb./sq. in.

level closely in relation to the evaporation rate, but which may also be used for the control of liquid levels in many other types of vessels. Also on show was the new Mobrey dual control which will shortly be available for working pressures up to 250 lb./sq. in., the function being to combine in one machine the operation of both electrically-driven feed pump control and low water cut-off with alarm for automatic firing apparatus

The Turbine Furnace Co. Ltd., 238B, Gray's Inn Road, London, W.C.1

"Turbine" patent furnaces, machine-fired, with fan forced-draught, were shown fitted to a single-flue shell-type boiler. The firing of the fuel on the grate is by means of shovel-type stoker equipment with very few moving parts. The furnace consists of a number of separate and distinct units lying side by side, and the design of the grate ensures that the distribution of the air over the whole of the effective area is uniform. As the firebar space is very fine the air is delivered to the fuel bed in the form of fine sprays, and as the bars are forwardly and downwardly projecting the resistance to the air passing along the trough is very low. Any size and class of solid fuel can be burned with the highest possible efficiency and records exist of tests made by independent authorities showing that efficiencies of over 75 per cent. on a bare boiler are possible. At the same time, smoke was definitely under control and forced secondary air can be fitted over hand or machine-fired "Turbine" furnaces. In addition to being suitable for installation to shell-type boilers large numbers of "Turbine" furnaces are in use all over the world on water-tube boilers burning a wide range of fuels.

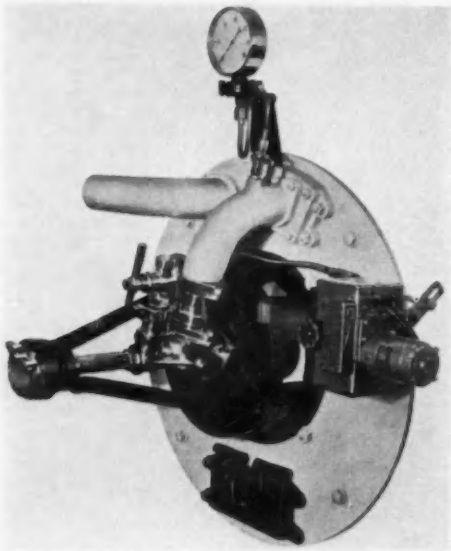
Versil Ltd., Rayner Mills, Liversedge, Yorks.

Versil Ltd., who are pioneers in the manufacture and development of glass fibre, exhibited a comprehensive range of glass fibre thermal insulations designed for the efficient conservation of fuel, together with the most modern engineering constructions for the insulation of nuclear and steam power plants and industrial installations, with examples of special finishes for every type of service. Examples of domestic insulation were also shown, and included the Versil glass fibre "Roofrap" an insulation in handy form for easy application in roof spaces of houses. Hot-water cylinder jackets and domestic pipe insulations were also exhibited. In the field of anti-pipe corrosions were shown a range of glass felt pipe wraps, and their application to underground pipe lines, together with glass fibre mats used as a reinforcement in the manufacture of plastic laminates. Also shown were Versil replacement-type air filter cells for providing clean air, and special steel retaining frames, for both front and side withdrawal.

Walker, Crosweller & Co. Ltd., Cheltenham

The Walker, Crosweller stand featured their Arkon instruments and Leonard thermostatic mixing valves. The main theme of the Arkon display was the use of remote reading instruments for gas and air flow, pressure, vacuum, etc. A working unit illustrated how up to

twelve readings can be sent simultaneously over a single telephone line. Two new instruments were exhibited :—a portable gas flow recorder used with a straight pitot tube, and a high differential recorder for the measurement of high-pressure gas, compressed air, steam or water. On the Leonard side, the display consisted of Leonard thermostatic mixing valves for steam and water and for hot and cold water.



The Wallsend regulated swirl-type low air pressure burner, with fully-modulating control of oil and air.

The Wallsend Slipway & Engineering Company Limited, P.O. Box No. 4, Wallsend-on-Tyne

The Wallsend Slipway & Engineering Co. Ltd., who claim to be the oldest established firm of oil-burner manufacturers in the country, showed a wide range of modern oil-burning equipment to meet the latest requirements in this field. The exhibits included a Wallsend pressure-jet burner with natural-draught air-distributor, a Wallsend-Kermode steam-jet burner arranged on swing cocks for natural or induced - draught, a Wallsend-Hubbard furnace front complete with Wallsend low air-pressure burner arranged with automatic controls and furnace safeguard equipment, a Wallsend low air-pressure regulated swirl-type burner arranged with automatic control of air distributor, and furnace safeguard equipment, and a Wallsend automatic ignition remote-controlled oil-burner complete with control cabinet, etc. Also shown was the Wallsend self-proportioning low air-pressure burner which has recently been developed and is now in production.

The West's Group of Companies, Albion Ironworks, Manchester, 10

This display illustrated the activities of the West's Group of Companies in relation to their work for the fuel industries, and dealt with various aspects of fuel efficiency—carbonisation for the production of the smokeless fuels gas and coke, complete gasification of low grade coals, coal preparation by dense medium separation and froth flotation, fuel handling, refractories, automatic process control, and structural work, etc. Refractory materials manufactured by the Derbyshire Silica Firebrick Co. Ltd., included "Dome" insulating material and "Peaksil" 95 per cent. silica, used in carbonising, glassmaking, steel and other industries ; "Thermax" clay-bonded siliceous material of high-density and low porosity, used in gas retorts ; "Srisil" Sillimanite material, employed in the glass industry, electric high-temperature oil and gas-fired furnaces, and muffles ; DSF "M" Aluminous, a high alumina refractory used for similar purposes ; and DSF Siliceous materials used in re-heating furnaces, checkers and steam boilers and in the carbonising industries.

George Kent Ltd. announce the appointment of a new director—**Mr. T. P. W. Norris,** lately chief personnel officer of the Vickers Group, previously labour manager of I.C.I., Billingham Division, and a former president of the Institute of Personnel Management. Mr. Norris has been appointed as deputy chairman. They also announce that **Mr. R. E. Handford,** B.Sc., deputy managing director, has, after 45 years in the company's service, 25 of which as a director, relinquished his executive functions but retains his seat on the board ; and that **Mr. W. A. Hartrop,** who joined the company in 1927 and was appointed to the board in 1943, has been appointed managing director. **Commander P. W. Kent,** formerly chairman and managing director, remains as chairman. Two other directors have also just retired, viz., **Mr. W. Guy Ardley,** who joined the firm in 1893 and became a director in 1914, and was joint managing director from 1938-1956, and **Mr. Leslie H. Kent,** who joined the company in 1913, and the board in 1915.

* * *

Crane Packing Ltd., Slough, one of the first companies in this country to process and fabricate PTFE (Polytetrafluoroethylene), have recently published a 26-page booklet describing this remarkable plastic. Contents include : processing of the basic raw material—moulding and extrusion—raw material forms—properties—material grades and their applications—PTFE components—dispersion coatings—the bellow's pump—bellows—the Fluoseal—"O" rings, etc. Descriptions are illustrated with photographs, diagrams, tables and charts to make this booklet an up-to-date and complete source of reference to PTFE.

* * *

Mr. S. H. Griffiths, F.Inst.M., M.Inst.W., head of John Thompson Limited group research laboratories, has been appointed a director of John Thompson (Wolverhampton) Limited. He joined the John Thompson organisation as a metallurgist in 1927, and was transferred to the Dudley company three years later. He returned, however, to the Wolverhampton company in 1934, to take charge of the laboratories and to supervise the X-raying of Class 1 pressure-vessels, of which at that time, John Thompson were the sole manufacturers in this country.

* * *

The Electric Construction Co. Ltd., has established a new Yorkshire area office at Bushbury House, 4 Laurel Mount, St. Mary's Road, Leeds 7. The area manager is **Mr. D. A. Laverack.**

* * *

Mr. C. E. Forster, B.Sc., A.M.I.E.E., divisional electrical engineer, Durham Division, National Coal Board, has been appointed chief engineer of the No. 6 (North West) Area, Durham Division, in succession to **Mr. A. A. Nichols,** who has retired.

A conference will be held by the **Combustion Engineering Association** on November 11th and 12th next at the Royal Hotel, Scarborough. The first day will be devoted to an examination of the fourth annual report of the **National Industrial Fuel Efficiency Service** and to analyse the findings of N.I.F.E.S. in its work with industry ; to highlight the inefficiency which has been found in the use of fuel and, at the same time, to show where the greatest savings can be made and how they can be most easily accomplished. Details of the second day will be announced shortly.

* * *

The Minister of Power has reappointed **Sir Giles Loder,** Bt., M.A., J.P., of Horsham, as a part-time member of the South Eastern Electricity Board, and **Mrs. C. Renton-Taylor,** of Leeds, as a part-time member of the Yorkshire Electricity Board.

* * *

To meet the ever-increasing demand for their products, and to accommodate their constantly expanding programme, **British Arca Regulators** will move on October 6th, 1958, from their present address at 34, Millbank, London, S.W.1, to more commodious premises at Sisson Road, Gloucester, where all administrative functions, and the manufacture of light engineering products will be carried out. The company's works at Ledsam Street, Birmingham, will continue the manufacture of all heavy equipment.

Latest Power Plant Patents

These extracts from British Patent Specifications are reproduced by permission of The Controller of H.M. Stationery Office. (Complete British Specifications can be obtained from the Patent Office, 26, Southampton Buildings, London, W.C.2. Price 3s. 6d. each, both inland and abroad.)

Heat exchanger

This invention relates to a shell and tube-type heat exchanger, capable of withstanding rapid temperature variations, for use with high temperature corrosive heating fluids. The shell of the unit is, in effect, a tube sheet. In Figs. 1, 2 and 3 the heat exchanger (10) comprises an outer, elongated shell (12) having dished end portions (14 and 16). Within the shell there is a bundle (24) of U-shaped tubes each of which has end portions (26) extending laterally through the wall of the shell (12) and arranged in a horizontal plane perpendicular to the vertical plane containing the U-bend of the tube. In Figs. 2 and 3 the tubes of the bundle (24) are shown divided into a number of groups (25), each group consisting of three or six tubes. The end of the tubes of each group pass through an opening (23) in the shell (12) and are connected to chambers (30) which are integrally attached to the shell (12) along the thick portion (18) of the shell. Each heat transfer element is a double tube, that is, two tubes (28 and 29) arranged, one within the other, with an annular space between them. The double tubes are constructed so that the outer tubes (28) have an increased diameter at the 90 deg. and 180 deg. bends to provide for differential thermal expansion of the inner tubes (29). Fig. 3 shows the construction of the chambers (30) and the arrangement of the tubes in them. Each chamber has a fluid space formed by the outer tube sheet (34) and closure head (36). In each head are the nozzle (38) and the inspection fitting (39). A second chamber (40) is formed by the outer tube sheet (34), the inner tube sheet (42) and a cylindrical portion (44). The inner tube sheet (42) is integrally attached to the shell (12) by the extension tube (46). The tube sheets (34 and 42) can be of less thickness than the portions of the cylindrical wall of the shell (12). This is because the sheets are of comparatively small diameter and are readily able to withstand the total force to which they are subjected. This is one of the advantages of the design, namely the tube sheets can be of a thickness less than the thickness of the portion of the pressure vessel wall to which the chambers (30) are attached. *British Patent No. 798,707 issued to The Babcock & Wilcox Company. Complete specification published July 23rd, 1958.*

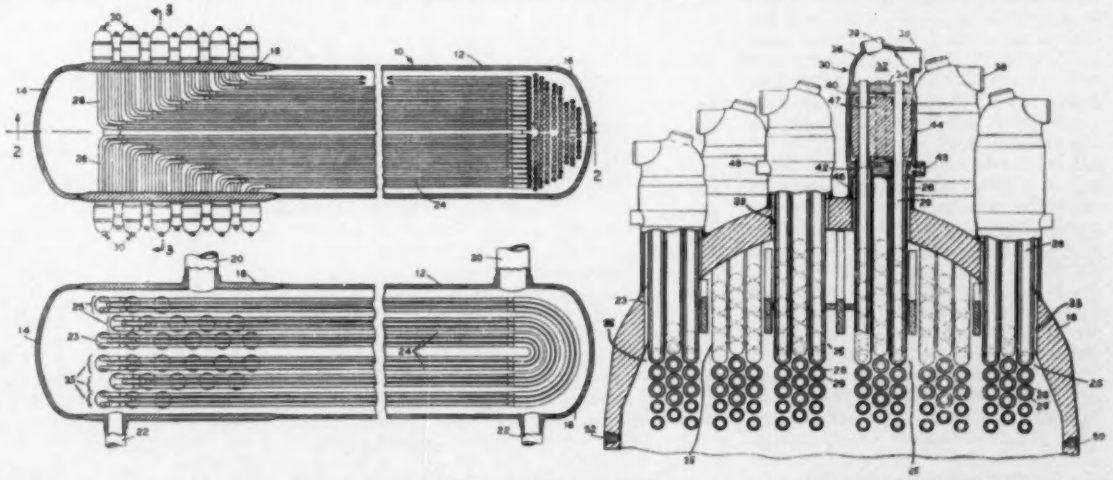


Fig. 1 (top, left). Fig. 2 (bottom, left). Fig. 3 (right). British Patent No. 798,707.

Air supply to travelling grate

When coal is burned on a travelling grate combustion starts and proceeds progressively as the coal is carried from the point of feed on the grate to the point of discharge. The combustion may be regarded as taking place in two main stages, the first stage consisting in ignition of the fuel, accompanied by the evolution of volatile matter due to destructive distillation, and the second stage in the burning of the residual coke. Since the second stage commences in the upper region of the fuel bed and extends gradually downwards as the fuel advances, the plane which divides the two portions of the fuel bed in which the respective stages are proceeding, and which may be called the "ignition plane" is inclined downwards until it intersects the plane of the grate, after which the combustion is wholly that of the second stage. The resistance to the flow of combustion air upwards through the fuel bed is greater in the first stage than in the second stage. Consequently, the resistance of the bed decreases progressively from the point of the feed to the point of discharge. As a result of this, more air tends to pass through the portions of the bed of lower resistance than is required for the combustion of the fuel in those portions, and insufficient air passes through the more solidly packed portions nearer the feed end. A furnace with a travelling grate and a combustion air distributing air chamber in accordance with the invention is shown in Fig. 4. The chain grate (1) is of the usual construction. The solid fuel is fed onto

the upper course of the grate from a hopper (2), and the depth of the fuel bed at the feed end of the grate is controlled by an adjustable guillotine (3). As indicated, the depth of the fuel bed (4) gradually diminishes from the feed end to the discharge end (5)

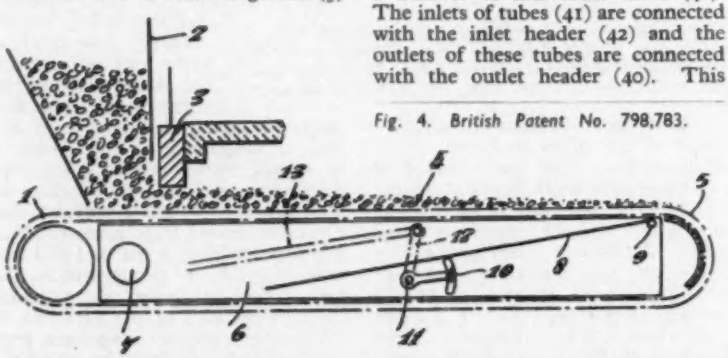


Fig. 4. British Patent No. 798,783.

of the grate. Beneath the upper course of the grate is provided an air-box (6) which is open at the top. Combustion air is admitted to the air-box (6) through an inlet (7) adjacent to the feed-end of the grate (1). The air box (6) is provided with a deflector plate (8) which is hinged within the air box at (9). The inclination of the plate (8) is adjustable by means of a crank-lever (10) fixed to a transverse shaft (11). To one end of the shaft (11) is fixed a lever (12), on which is pivoted a connecting rod (13), which can be operated to rotate the shaft (11), and so raise or lower the crank-lever (10) acting on the underside of the deflector plate (8). The deflector plate thus forms within the air-box (6) a passage of gradually diminishing depth for the combustion air which flows horizontally from the inlet (7) and is deflected by the plate (8) upwards through the grate (1) into the fuel bed. Accordingly, the resistance to the flow of the air increases towards the discharge end, so that more air will tend to pass upwards from the passage into the fuel bed at the feed-end, where the passage is deeper. *British Patent No. 798,783 issued to C.U.R.A. Patents Limited. Complete specification published July 30th, 1958.*

Steam generator

This invention relates in particular to boilers supplying superheated steam to two inlets of a turbine. The superheater of the forced-flow boiler shown in Fig. 5 is divided into two sections, the low-temperature stage (32) in gas pass (22), and the high-temperature stage (34) in gas pass (27). Steam from the drum (24) is conveyed through pipe (36) to the low-temperature stage (32), and from this stage the steam is passed through pipe (38) to the high-temperature stage (34) where its temperature is raised to the desired value, the steam entering the outlet header (40) after passing through this high-temperature stage. The high-temperature stage comprises a number of individual tubes (41). The inlets of tubes (41) are connected with the inlet header (42) and the outlets of these tubes are connected with the outlet header (40). This outlet header is of special construction and is connected with the tubes of the high-temperature stage (34) in a particular manner in order to ensure that the steam delivered to pipes (44 and 46) is of the same temperature. To this end, the outlet header comprises two elongated headers (48 and 50) placed above the upper wall (52) of the gas pass (27) and extending transversely of the gas pass, Fig. 6. Pipe (48) is preferably located directly above pipe (50). These two pipes are positioned above the vertical outlet portions of tubes (41) and are joined at their central portion by a connector (54) in order to provide for steam to flow from one of the pipes to the other. In order to ensure that the temperature of the steam entering each of the pipes from tubes (41) is the same, the tubes (41) across the gas-pass (27) are alternately connected to the headers (48 and 50). By this arrangement, the steam entering each of these headers (48 and 50) will be of substantially the same temperature due to the fact that the tubes connected to each of these pipes are equally spaced across the width of the gas-pass and, therefore, swept by combustion gases of the same temperature, and the same mass flow. Although alternate tubes (41) are connected to a different header (48 or 50), it will be understood that other arrangements for ensuring equal steam temperatures in these two pipes are possible. For example, the tubes may be connected in pairs. The steam collected in pipe (48) is passed through pipe (44) to the left inlet of turbine (12), while the steam collected in pipe (50) is passed through pipe (46) to the right inlet of turbine (12). In each of these pipes are the usual valves (56), which include the turbine stop and interceptor valves, the latter being automatically regulated to close in certain instances to prevent the turbine from overspeeding. Under normal conditions there will be little or no steam flow from pipe (48) to pipe (50), or vice versa, through connector (54). However, should for any reason either of the valves (56) close, steam from the pipe associated with the closed valve will flow through

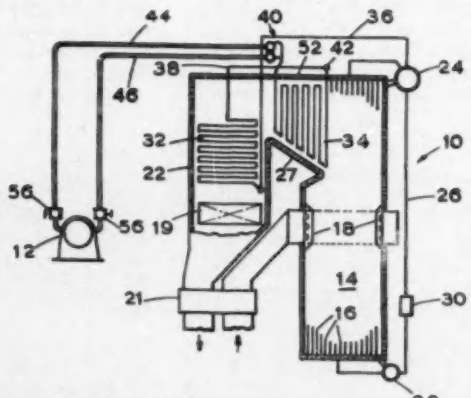


Fig. 5. British Patent No. 798,785.

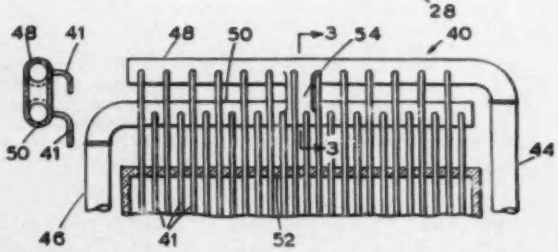


Fig. 6. British Patent No. 798,785.

connector (54) into the other pipe, thereby preventing overheating of the tubes associated with the first mentioned pipe. *British Patent No. 798,785 issued to Combustion Engineering Inc. Complete specification published July 30th, 1958.*

Boiler with superheater and reheater

This invention concerns boilers operating under the reheat cycle in which the superheated steam after having given up part of its energy in a turbine is reheated and returned to the turbine for further use. In the outline arrangement, Fig. 7, the combustion gases, after leaving the furnace outlet (14), pass through a horizontal gas offtake (26) into a

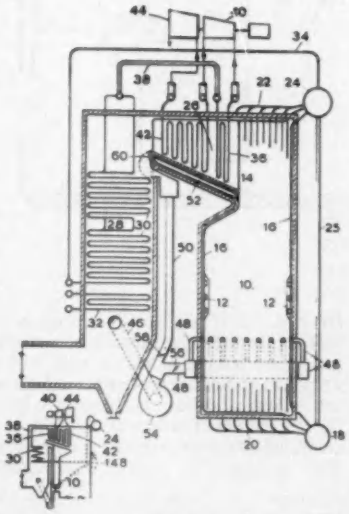


Fig. 7 (left). British Patent No. 798,786.

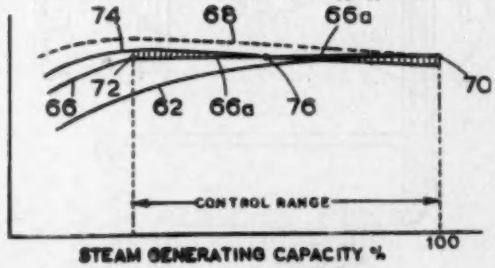


Fig. 8 (right). British Patent No. 798,786.

vertical gas pass (28) from which they are discharged into a stack. Gas pass (28) contains a first-stage superheater (30), and may house also other heat absorbing equipment such as an economiser (32). The steam from the boiler drum is passed through tubes (34) to the superheater (30) ; it then passes through pipe (38) to the final superheater section (36) from whence it is delivered to the high-pressure turbine (40). The steam is returned from the turbine to reheater (42) and returned in heated state to the turbine. To facilitate the control of the reheated steam temperature, burners (12) may be of the tilting type. The reheated steam temperature can also be controlled by returning relatively cool gases to the furnace. Gas recirculating ducts (46 and 48) lead from the lower portion of vertical gas-pass (28) to the furnace (10) below the burners (12). In addition, gas recirculating ducts (46 and 50) are provided between the lower portion of vertical gas-pass (28) and the upper portion of the gas-pass, to a point directly ahead of the primary superheater (30). A fan (54) associated with the ducts delivers gas under pressure through ducts (48) into the furnace. The amount of gas recirculated into the furnace is largely controlled by the damper (56). Fan (54) can also deliver recirculated gases through duct (50) into the upper portion of gas-pass (28). Damper (58), in co-operation with damper (56), controls the flow of gas thus recirculated through duct (50). A gas bypass (52) permits gas-flow from the upper part of the furnace to a point behind reheater (42) and directly ahead of the primary superheater (30). At the outlet of bypass (52), a damper (60) can restrict either the flow through bypass (52) or the flow out of recirculating duct (50). Fig. 8 illustrates in graphic form how it is possible to install a superheater having less heating surface than a comparable superheater utilising desuperheating. In Fig. 8 there are shown four curves representing steam temperatures for various steam generator capacities ; three of these curves, namely curves (62, 66 and 68), represent the uncontrolled reheat temperature, controlled reheat temperature and uncontrolled superheated steam temperature respectively. The fourth curve (74) represents the as yet uncontrolled superheat temperature in a boiler according to the invention. Curve (74) runs approximately parallel with curve (68), but at a lower temperature range, and bisects curve (66) at point (76). This means that the superheater with a temperature characteristic (74) contains less heating surface than the superheater represented by characteristic (68). If it is assumed that the desired steam temperature is the same as the desired steam temperature of the reheated steam, or, in other words, that curve (66, 66a) not only represents the reheat temperature held constant between maximum load and load control point (points 70 and 72), but also represents the desired temperature of the superheated steam held constant over the same load range, then the cross-hatched area below curve (66) and below curve (74), and the cross-hatched area below curve (66) and above curve (74) represent the amount of controlling required to raise or lower respectively the superheated steam temperature to the desired level at various loads. This control is accomplished by bypassing hot gases through bypass (52) at loads lying between the maximum capacity and the capacity represented by point (76). At loads below point (76) and above the control point load represented by point (72), cooled gases are recirculated through ducts (46 and 50) to a point directly ahead of the first-stage superheater section (30) in order to lower the superheated steam temperature. *British Patent No. 798,786 issued to Combustion Engineering Inc. Complete specification published July 30th, 1958.*

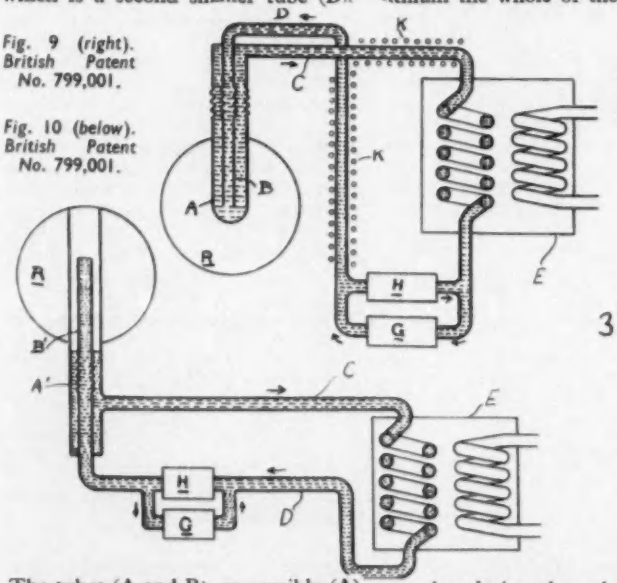
Nuclear reactor

This invention relates to nuclear reactors. It is applicable to both fission and fusion reactors, and has an important application in fast fission reactors. Hitherto, difficulty has been experienced in controlling fast reactors on account of the problem of satisfactorily absorbing fast neutrons. The main object of the invention is to provide an improved arrangement for controlling fast reactors. Ducting extends from the outside of the reactor for an appreciable distance within the core of the reactor. This ducting is formed from two concentric flow and return pipes. Means are provided for circulating neutron absorbing liquid through the ducting so that the liquid enters the core along one pipe and emerges from the core along the other pipe. Means are provided for varying the volume of neutron-absorbing liquid within the ducting. The neutron-absorbing liquid used in the ducting may conveniently be liquid lithium. Lithium is a very suitable material for such control since it is both able to slow down neutrons very efficiently and also to absorb the neutrons which have been slowed down. Furthermore, it melts at a temperature of 186 deg. C. and is therefore liquid at

the high temperatures which are anticipated in fast reactors. Fig. 9 shows diagrammatically, one method of achieving the desired control. (A) is a control rod consisting of a tube, for example, of stainless steel or suitable high temperature alloy inside which is a second smaller tube (B).

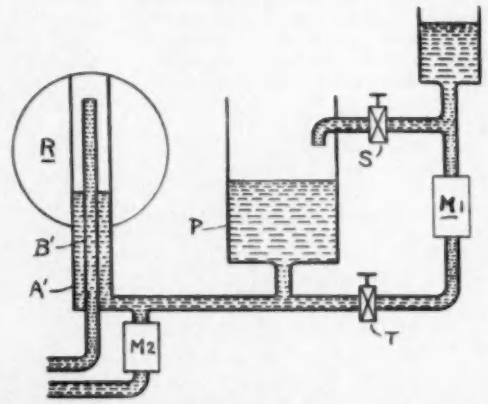
Fig. 9 (right). British Patent No. 799,001.

Fig. 10 (below). British Patent No. 799,001.



The tubes (A and B), or possibly (A) only, extend into a core (R) connected by expandable couplings to fixed external pipes (C and D), so that the assembly, or possibly the outer tube (A) only, may be inserted or withdrawn over a limited range within the reactor core. Liquid lithium is circulated through pipe (D) into the control rod via tube (B) and returns through tubes (A and C) to a heat-exchanger (E) where heat is removed, and so back to the pump (G). A small by-pass (H) permits continuous removal of by-products, and any necessary replacement of lithium. The whole system may be provided with heating coils (K) to maintain the lithium in liquid form when the reactor is shut down or operating at very low power. The lithium may be suitably alloyed, e.g. with sodium, to reduce the melting point. In another arrangement as shown in Fig. 10, the lithium may be pumped up a central movable tube (B^1), returning by gravity down an outer tube (A^1) whence it is pumped away through an external heat-exchanger with by-pass for reaction product removal. The level of liquid lithium in the reactor is then maintained at the desired level by inserting or withdrawing the central tube. Alternatively, as shown in Fig. 11, no moving tubes are used. Lithium is pumped up the small central tube (B) thus affecting the level in the outer tube (A^1). The level in the outer tube follows the level in the reservoir (P) which is controlled by means of the pumps (M) and valves (S and T). Rapid shut-down of the reactor is obtained by flooding with liquid lithium the whole of the outer tube, e.g. by closing the valves (L or S), or flooding from some external reservoir. *British Patent No. 799,001 issued to Metropolitan-Vickers Electrical Company Ltd. Complete specification published July 30th, 1958.*

Fig. 11 (below). British Patent No. 799,001.



Boiler with superheater and de-superheater

In steam generators, the temperature of the superheated steam can, of course, be controlled by surface coolers or desuperheaters. Boiler water is generally used to cool the superheated steam. The heat-exchange surface necessary is often placed in the drum of the steam generator. In this way, however, the accessibility of the drum is hindered and the real purpose of the drum, viz. that of the separation of the steam, is disturbed. It is also necessary to bore the drum walls for the inlet and delivery tubes of the desuperheater. The separation of steam is disturbed by bubbles of steam which are formed on the heat-exchange surface and rise from the water surface, and the load on the steam chest is increased. It is an object of this invention to provide an improved steam generator of this kind. In such a generator, an intermediate collector fed by steam and water mixture by heated riser tubes is provided, and a tubular heat-exchanger for the cooling of the superheated steam is disposed in it.

In Fig. 12 is shown a longitudinal section through the furnace of a steam generator having a steam and water drum (1) and an intermediate collector (2). Cooling tubes (3) through which the superheated steam is to flow are arranged in the intermediate collector. The mixture of steam and water

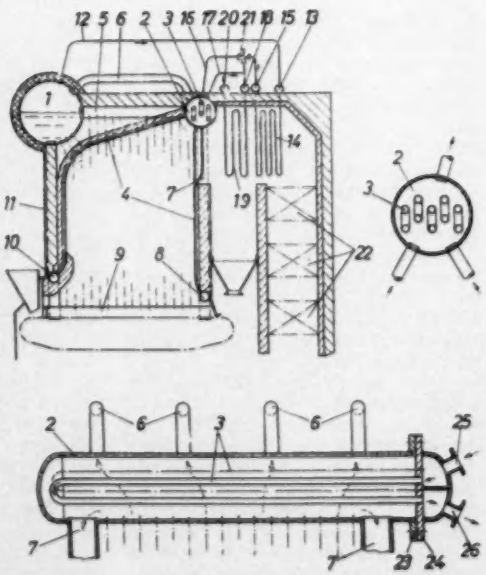


Fig. 12 (top, left).
Fig. 13 (top, right).
Fig. 14 (right). British Patent No. 799,060.

flows from the intermediate collector (2) to the drum (1), through unheated tubes (5) which serve at the same time as collecting headers for the heated side-wall tubes. The tubes or headers (5) are connected to the drum (1) by one or more unheated high-level overflow tubes (6) which lead into the steam space of the drum. Downcomer tubes (7) are connected to the intermediate collector (2), whereby part of the circulating-water flows back to the distributing headers (8, 9 and 10), so that the load on the downcomer tubes (11) which lead directly from the drum (1) is considerably reduced, and also the separation of steam and water in the drum (1) is facilitated. The flow of the steam through the superheater and cooler is as follows. In the tube (12) saturated steam flows from the drum to the distributing header (13) of a section (14) of a superheater. The superheated steam flows from the collecting header (15) of the superheater section (14) through a pipe (16) into the cooling tubes (3) of the superheated steam cooler and thence through a pipe (17) into the distributor (18) of a superheater section (19). From the collector (20) of the section (19) the superheated steam is then led to the point of consumption. Between the pipes (16 and 17), a mixing valve (21) is fitted which permits the superheated steam cooler (3) to be by-passed and thus provides for corresponding control of the temperature of the superheated steam. Further heat-exchange surfaces such as economisers (22), are arranged successively behind the superheater sections (19 and 14). Fig. 13 shows a longitudinal-section and Fig. 14 a cross-section through the intermediate collector (2) with incorporated superheated steam cooler. From Fig. 14 the freedom for expansion of the cooling tubes (3) in the intermediate collector (2), which effects a preliminary separation of steam and water, can be appreciated. *British Patent No. 799,060 issued to H. Vorkauf. Complete specification published July 30th, 1958.*

The new London headquarters of **Shell Petroleum Co. Ltd.,** Britain's largest commercial office building, now being built on a site at South Bank, near Waterloo station, will be heated by three Babcock oil-fired corner-tube high-pressure hot-water boilers, comprising two 40 million B.Th.U./hr. units, and one of smaller capacity. These have been ordered from **Babcock and Wilcox, Limited** by **G. N. Haden and Sons Limited,** the heating and ventilating engineers. The corner-tube boiler is a highly efficient forced-circulation boiler for modern high-pressure hot-water heating and process systems, of a new design which provides for an inherent degree of natural circulation with the resulting advantages of safety and reliability in operation. It is manufactured by the Babcock organisation with a choice of firing using various fuels, and in capacities from 2½ million B.Th.U./hr. up to the maximum for any heating requirement.

* * *

Laboratoire Pacaut and Veyron, of France, have made arrangements for **Combustion Chemicals Ltd.,** Elcot House, 33, Dorset Square, London, N.W.1, to be sole concessionaires in the United Kingdom, Commonwealth, Scandinavia and the Americas for their well-known fuel oil and diesel fuel improvers, "Desulfurol" and "Dieselfur." These products have been proved and established in France over many years, and are in constant use by many of the major industrial concerns in that country. "Desulfurol" is also well known in the U.K., where extremely good results in improved combustion and reduction in sulphur corrosion, together with elimination of the soot and smut emission problem, are claimed to have been achieved in extensive trials.

* * *

The **Cambridge InstrumentCo.** have issued a new four-page publication (list-144/B/11) describing accessories such as aspirators, absorption chambers, flow gauges, etc., which are employed with Cambridge gas analysers of the thermal conductivity type. This supplements list-144/B/1, which describes analysing equipment for a wide range of gas combinations.

An order has been placed with **The English Electric Company Limited** for turbine plant for the United Kingdom Atomic Energy Authority's new advanced gas-cooled reactor. The contract is for a 33-MW steam turbo-alternator set, condensing and feed heating plants with auxiliary apparatus. The new reactor will contribute to the U.K.A.E.A. programme to realise the maximum development potentiality of the gas-cooled graphite-moderated reactor during the 1960s. The turbine will be of the two-cylinder impulse reaction type operating at a speed of 3,000 r.p.m. with steam at 650 lb./sq. in., and a temperature of 850 deg. F. The alternator will be air-cooled. This plant will be commissioned in 1961 and will be manufactured at The English Electric Company's Rugby, Stafford and Netherton works. The unit is a well-tried design, of which 70 are already in service, including 12 supplied to the Electricity Commission of South Africa for the Vierfontein Power Station.

* * *

A new catalogue describing their recently introduced Class F.E. range of horizontal double-acting balanced opposed compressors has been issued by **The Consolidated Pneumatic Tool Company,** 232, Dawes Road, London, S.W.6. This 12-page brochure gives full details of design, application and operation, together with detailed specifications of operating examples. Components parts are illustrated in detail and a wide use has been made of both illustrations and line diagrams. After an introduction dealing with considerations of design involved in eliminating vibration, full construction details are given of the frame, crankshaft connecting rods, cross-heads, bearings, cylinders and pistons, lubrication, intercoolers and automatic control. This section is followed by specifications of various units ranging in capacity up to 5,000 cu. ft./min. and pressures up to 3,000 lb./sq. in.

* * *

"Sulphuric Acid Plants" is the title of an 80-page book published by **Simon-Carves Ltd.,** Cheadle Heath, Stockport. This deals very fully with the subject, and in addition contains a section devoted to relative technical data, in the form of tables, etc.

In the May issue of this journal we made reference to the **George Kent Mobile Exhibition** which earlier this year had toured the Ruhr and the industrial centres of Belgium, and then took part in the ACEMA Exhibition at Frankfurt. This Mobile Exhibition commenced, on Monday August 25th, another extensive tour of the Continent and Scandinavia. Since its previous Continental tour showing Kent industrial instrumentation, the exhibition has had an encouraging reception at a number of important industrial centres in the United Kingdom. Now, featuring the very latest electronic developments, it is scheduled for visits to Sweden, Norway, Denmark and Poland, where the visits will be carried out in full co-ordination with the members of the Kent sales organisation in the territories concerned.

* * *

Wallace and Tiernan Ltd., Power Road, London, W.4, have published a number of technical publications describing their equipment, in French and German. Publications in French describe the new V-Notch Chlorinator type A-711B, Chlorinator type A-678B and Chlorinator type A-419B. While, in addition, publications in French are available describing the new Dissolved Oxygen Recorder, E.C.D. pumps and E.C.D. ozone equipment. A booklet on the "Chlorination of Condenser Cooling Water" is also available in French. Publications in German describing the equipment are also available from the company at the above address, or from their factory in Germany.

* * *

Spencer-Bonecourt-Clarkson Limited (subsidiary of Babcock and Wilcox Ltd.) have issued a new brochure (publication No. 1533/1), entitled "Waste Heat Recovery." This brochure, of some 46 pages, includes comprehensive information concerning waste-heat recovery, waste-heat boiler design, and the application of waste-heat boilers for service in gas works, steel works, water-gas plants and other industrial installations. Information is also given regarding the application of waste-heat boilers to be used in connection with internal-combustion engines, including marine applications.

NOTES Personal AND Industrial

Mr. J. C. Mitchell, O.B.E., M.I.Mech.E., M.I.E.E., controller of the North Eastern Division of the Central Electricity Generating Board, retired on September 30th, after over 40 years in the electricity supply industry. Mr. Mitchell joined the staff of the Newcastle upon Tyne Electric Supply Company, (later the North Eastern Electric Supply Co. Ltd.) in 1920, and soon afterwards became superintendent of the North Tees Station, a position he held for 14 years. In 1935, he was transferred to the company's headquarters, eventually becoming chief mechanical engineer, which post he held until his appointment as divisional controller upon nationalisation.

* * *

Mr. John F. Perry, who recently retired as managing director of Metropolitan-Vickers Electrical Export Co. Ltd., has accepted an invitation of the directors to join the board of Fluidrive Engineering Co. Ltd., Isleworth, Middx. Mr. Perry has been closely connected with the activities of Fluidrive Engineering Co. Ltd. for many years, having been largely responsible in 1928 for pioneering Fluidrive in flywheel generator sets for mine winders.

* * *

Mr. J. Higginbotham has been appointed deputy general manager of Edgar Allen and Co. Ltd. In 1953, he was appointed commercial manager, representing the company in the Middle East, Israel and Portugal in connection with cement plant contracts. **Mr. J. D. Studholme** has been appointed assistant general manager of the company. He first joined the drawing office of the engineering department in 1949, and after service with another firm as development engineer, he rejoined Edgar Allen and Co. Ltd. as developement enginer.

* * *

Mr. George Campbell, B.Sc., A.R.C.S.T., F.R.I.C., A.M.I.Mech.E., has been appointed general manager of the Chemical and Metallurgical Division of the Plessey Company Limited. He was previously technical manager and deputy general manager of the company's Towcester plant.

* * *

Samuel Fox and Co. Ltd., a subsidiary of the **United Steel Companies Limited,** states that **Mr. H. Morley** has become general works manager. He succeeds **Mr. J. D. Joy,** who has been appointed a director and general works manager of **Appleby-Frodingham Steel Company. Mr. C. M. Slocombe,** until recently director and chief engineer of **Samuel Fox and Co. Ltd.,** has been appointed director of engineering, and **Mr. J. Hammond** is now chief engineer. **Mr. H. J. Strong** has joined the company to work with the chief engineer, with a view to becoming works engineer on January 1st, 1959.

Mr. F. C. Lant, O.B.E., M.Inst.F., A.M.I.H.V.E., has been appointed chief fuel engineer to the Ministry of Power in succession to **Rear Admiral Sir Sydney O. Frew,** K.B.E., C.B., who has retired from the public service. Mr. Lant joined the Ministry as a regional fuel engineer in 1948 and has been responsible, under the chief fuel engineer, for both industrial and domestic fuel efficiency matters. He was appointed O.B.E. in the Birthday Honours List, 1954.

* * *

James Hodgkinson (Salford) Ltd., who have expanded their activities recently by the acquisition of Bennis Combustion Limited and J. & J. Neil (Temple) Limited, announce that **Mr. R. Yeoman** has been appointed general manager for the group's foundries. Previously, Mr. Yeoman was foundry manager for the parent company, and this new appointment is to ensure efficient co-ordination of all foundry work within the group.

* * *

Mr. A. L. Napier, who had been a director of John Thompson Water Tube Boilers Company, Wolverhampton, since 1930, retired recently after serving the John Thompson Group for fifty years. Until his retirement (which was marked by Sir Edward Thompson, J.P., chairman, John Thompson Limited, presenting him with his fifty years' service medal and presentations from directors and staff), Mr. Napier was a member of the British Standards Council of the Water Tube Boiler-makers' Association.

* * *

Rhodes, Brydon & Youatt Ltd., Stockport, announce the establishment of new offices in Birmingham and Newcastle upon Tyne. The addresses of these offices are :—Griffin House, Ludgate Hill, Birmingham 3. Telephone : Central 8911/2 (Midlands area manager : **Mr. C. M. Saunders**) and 60, Highbury, Jesmond, Newcastle upon Tyne, 2, Telephone : 81-4722. (Northern Counties manager : **Mr. M. J. B. Hodgson,** B.Sc.).

* * *

It is with regret that we record the recent death of **Mr. W. R. Symons,** who was Lancashire representative of Crosthwaite Furnaces and Scriven Machine Tools Ltd. Mr. Symons had been with the company for 55 years.

* * *

The executive and sales organisations of **Whiffen & Sons Ltd.** are now concentrated entirely at their Loughborough factory. All enquiries and correspondence should, therefore, be addressed to Willows Works, Derby Road, Loughborough, Leicester. The Publicity and Advertising Department remains in London at Fison House, 95, Wigmore Street, London, W.1. It is, however, still possible to contact members of the sales organisation through Fison House.

The Minister of Power has appointed **Mr. K. J. Lynes,** B.Sc., Ph.D., of Sandwich Bay, and **Alderman J. W. Perkins,** A.M.I.E.E., of Surbiton, to be members of the South Eastern Electricity Consultative Council.

* * *

Mr. J. T. Sharples, A.M.I.Mech.E., has joined the British Electrical Development Association as industrial heating engineer.

* * *

The range of variable-speed drives manufactured by **Lancashire Dynamo Nevelin Ltd.,** Oxted, Surrey, has been further extended by the introduction of the Nevimag drive, which consists of a transductor-controlled Ward Leonard set providing a high accuracy performance over a wide range of speeds. Details of the equipment, operation and performance are contained in a new publication (List NV.400) now available from the company.

* * *

Monsanto Chemicals Ltd. announces that **Mr. D. C. M. Salt** has been appointed general manager of the chemical division, and **Mr. G. Dodd** as general manager of the plastics and special products division. **Mr. J. V. Head** succeeds Mr. Dodd as acting controller of purchases.

* * *

George Kent Limited, have published a leaflet giving addresses and details of Kent organisations throughout the world. These details are published in order to assist contractors, consulting engineers and others when overseas projects are being considered. Copies of this publication (1008) may be obtained upon application to the company at Luton.

* * *

Ashmore, Benson, Pease and Company of Stockton-on-Tees, a member of The Power-Gas Group, announce the following new appointments. **Mr. G. B. Taylor** becomes sales manager (works division) and **Mr. R. H. Foster,** A.M.Inst.C.E., works manager.

* * *

The London sales office, and the sales and service staff of **Elecontrol Ltd.** are now located at the company's works at Wilbury Way, Hitchin, Herts.

* * *

The Power-Gas Corporation Limited, Stockton-on-Tees, **John Thompson Limited,** Wolverhampton, and **Humphreys and Glasgow Limited,** London, have formed a new company—**Nuclear Chemical Plant Limited,** which will be concerned with the design and engineering of process and treatment plant for the nuclear industry. Each of these companies has experience in meeting the requirements of the nuclear energy industry, and their resources will now be available to the new company in the new field of process and treatment plant.

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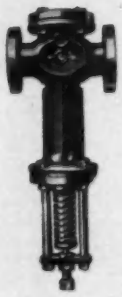

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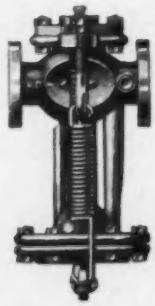

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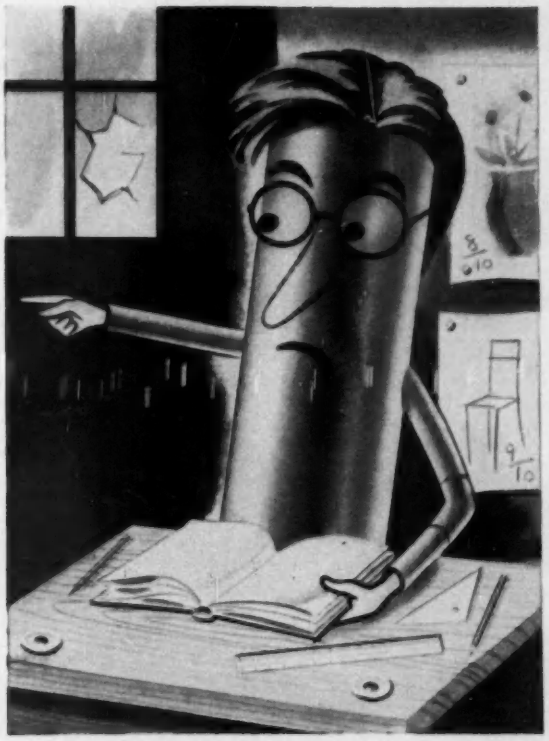

I was always in hot water—or rather hot water was always in me—when I left the boiler-room. But then I wandered about the school, improperly dressed. I used to dissipate my heat in draughty corridors. By the time I reached the dorm' radiators, I was as tepid as school tea!

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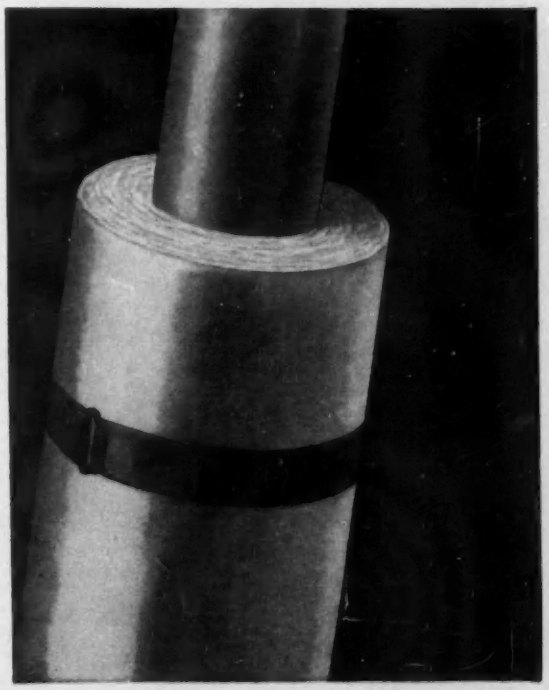

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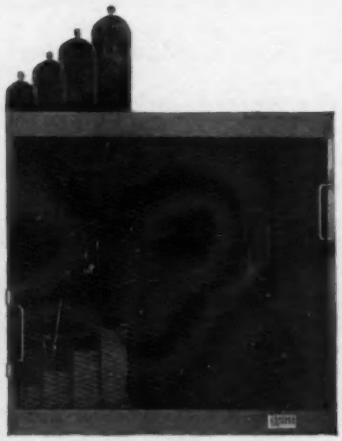

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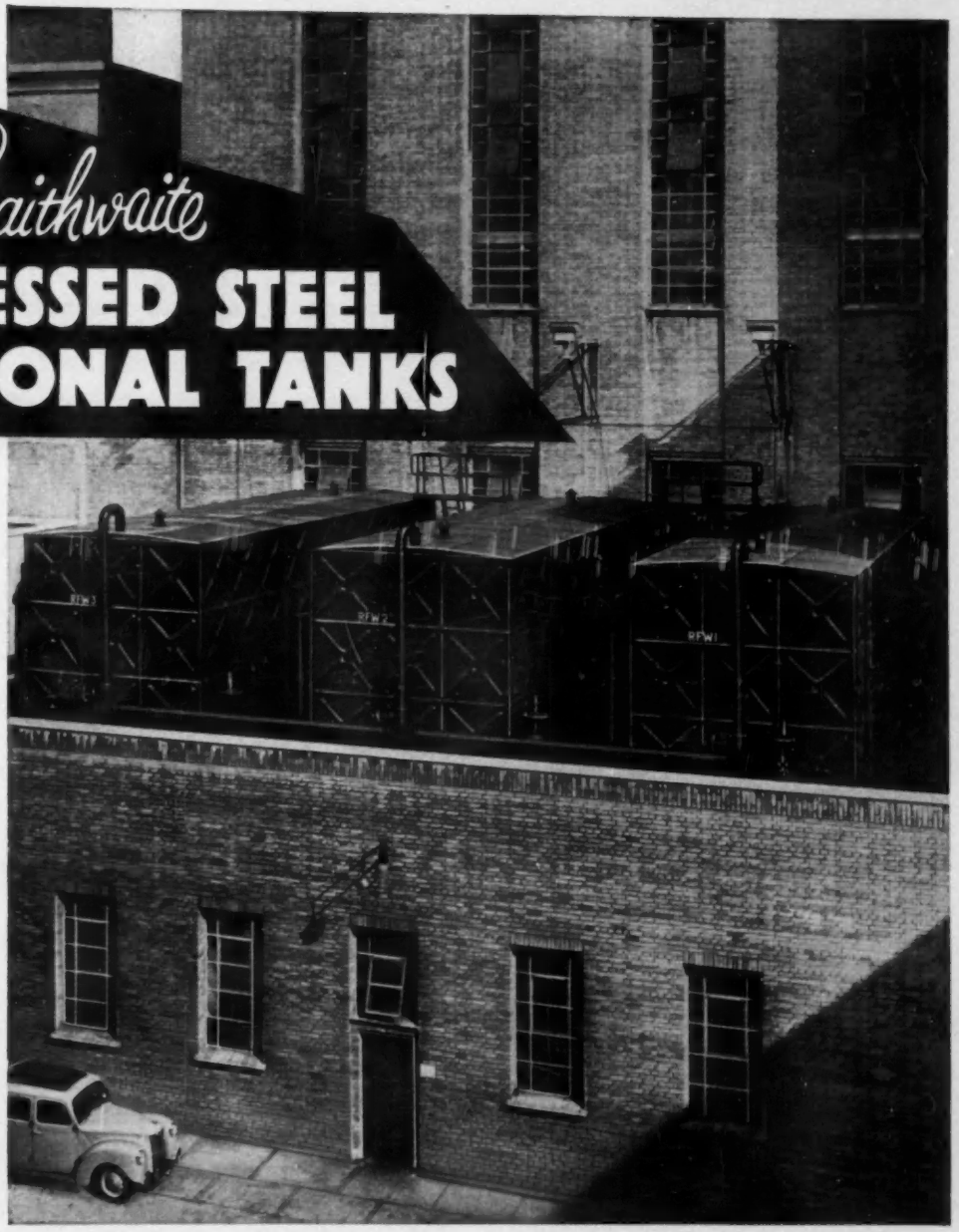

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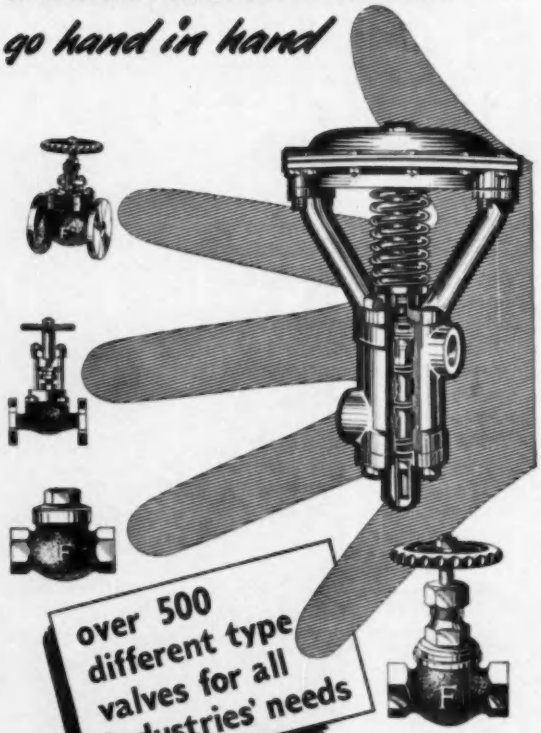

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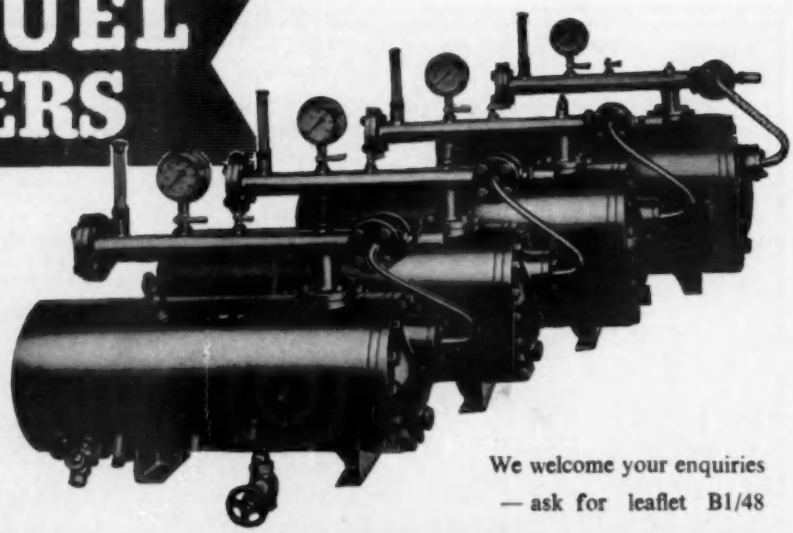

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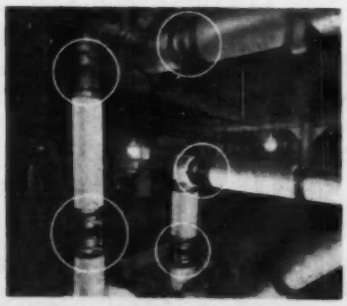

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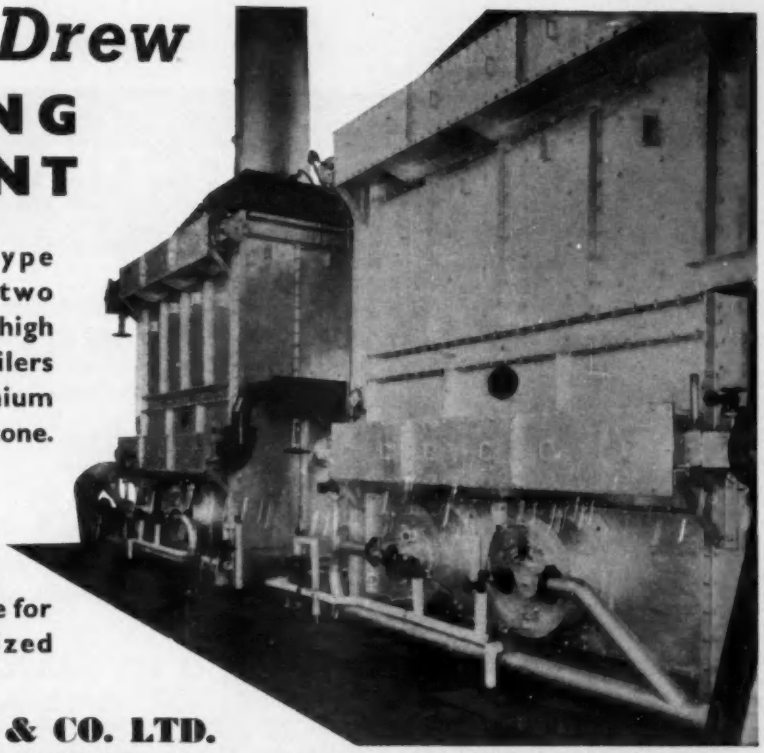

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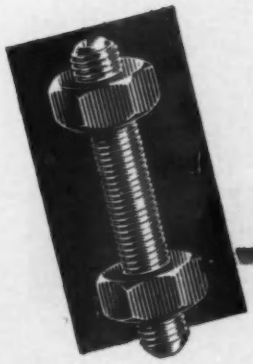

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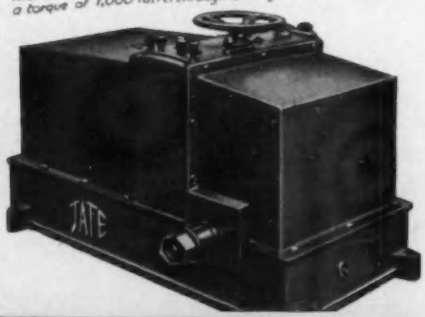

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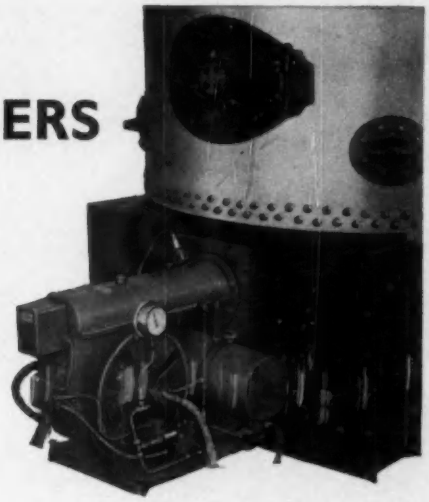

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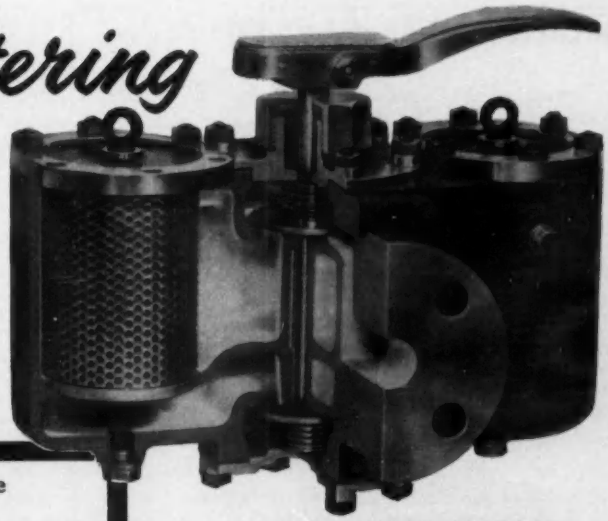

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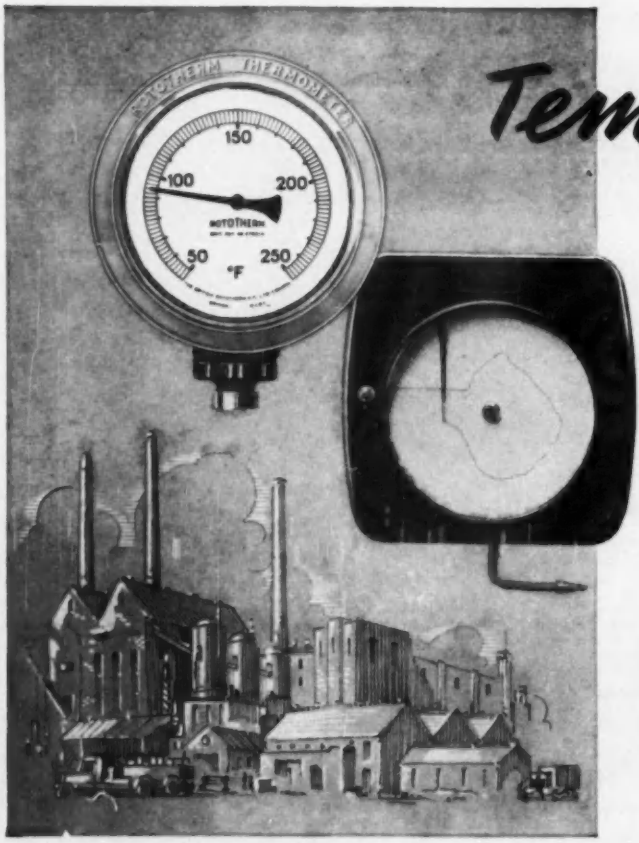

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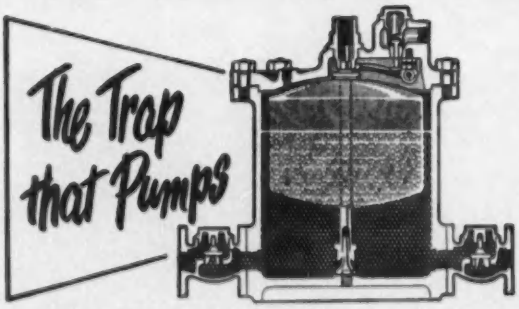

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Index to Advertisers

	Page
Atlas Preservative Co. Ltd.	xxiii
Auld, David & Sons Ltd.	lxxii
Automotive Products Ltd.	ii
Babcock & Wilcox Ltd.	lxx
Bouellat Eng. Co. Ltd.	xii
British Boiler Accessories Ltd.	lix
British Ermeto Corporation Ltd.	lxxix
British Industrial Eng. Co. (Staffs.) Ltd.	xlvii
British Paints Ltd.	xvi
British Rototherm Co. Ltd.	lxxxiv
British Thomson-Houston Co. Ltd.	xl
British Vacuum Cleaner & Eng. Co. Ltd.	lviii
Caird & Rayner Ltd.	lxxviii
Cape Asbestos Co. Ltd.	xlvi
Chemical & Insulating Co. Ltd.	lxxi
Clarke, Chapman Ltd.	xlviii
Classified Advertisements	lxxxvi
Clyde Blowers Ltd.	l
Copes Regulators Ltd.	lxiv
Cory, Wm., & Sons Ltd.	liv
Crane Ltd.	xiv
Danfoss Manufacturing Company	lxviii
Danks, Edwin, & Co. Ltd.	xliii
Defur Descaling Services Ltd.	lxxxii
Dewrance & Co. Ltd.	xvii
Electroflo Meters Co. Ltd.	Front cover
Fibreglass Ltd.	lxxiii
Fireye Controls Ltd.	xix
Fluidrive Eng. Co. Ltd.	vii
Foster Transformers Ltd.	lxxxv
Fraser & Fraser Ltd.	xxxiv
General Refractories Ltd.	xxxii
Glenboig Union Fireclay Co. Ltd.	xxx
Green, E., & Son Ltd.	xxxvii
Greenwich Insulation Co. Ltd.	lxxvii
Hargreaves Ltd.	lxv
Hayward Tyler Ltd.	xxxix
Heather Filters Ltd.	lxxiv
Hick Hargreaves & Co. Ltd.	xxix
Hodgkinson, James, (Salford) Ltd.	xv
Holmes, W. C., & Co. Ltd.	xlix
Hopkinsons Ltd.	xxxiii
Hunt & Mitton Ltd.	lxxvi
Ivor Power Specialty Co. Ltd.	ix
Jones, Tate, & Co. Ltd.	lxxxii
Judd Budd Ltd.	xxxiv
Keith Blackman Ltd.	xxii, Back Cover
Lafarge Aluminous Cement Co. Ltd.	lvi
Laidlaw, Drew & Co. Ltd.	lxxxi
La Mont Steam Generator Ltd.	xxxviii
Lancashire Dynamo & Crypto Ltd.	xxxv
Lancashire Dynamo Electronics Products Ltd.	xlv
Lancaster & Tonge Ltd.	lxxviii
Lock, A. M., & Co. Ltd.	lxxii
Magnetic Valve Co. Ltd.	xxviii
Marshall Sons & Co. Ltd.	lxi
Morgan Refractories Ltd.	xxxvi
M.S. Smoke Elimination Co. Ltd.	lxxxiv
National Industrial Fuel Efficiency Service	lxxxv
Newalls Insulation Co. Ltd.	xx
Newton Chambers & Co. Ltd.	lvii
Parsons, C. A., & Co. Ltd.	lxii
Peabody Ltd.	lxxvi
Permutit Co. Ltd.	iii
Prior Stokers Ltd.	lxxxiii
Proctor, J., Ltd.	lxxix
Reavell & Co. Ltd.	lxxvii
Richardsons Westgarth & Co. Ltd.	li
Ruston & Hornsby Ltd.	lxvi
Shaw, Son & Greenhalgh Ltd.	viii
Simon-Carves Ltd.	x, xi, lii
Slip Group of Companies	liii
Smith Bros. & Co. (Hyson) Ltd.	lxxviii
Solignum Ltd.	xxvi
Spencer-Bonecourt-Clarkson Ltd.	xviii
Spirax-Sarco Ltd.	xli
Stein, J. C., & Co. Ltd.	lxvii
Sulzer Bros. (London) Ltd.	iv
Superheater Co. Ltd.	lxxxvii
Teddington Aircraft Controls Ltd.	lxxx
Thermix Industries Ltd.	xlii
Thompson, J., Conveyor Co. Ltd.	xxi
Thompson, J., (Wilson Boilers) Ltd.	v
Thornycroft, John I., Co. Ltd.	lxxiv
Turbine Furnace Co. Ltd.	xxvii
United States Metallic Packing Co. Ltd.	lxxxiv
Vincent Davis Glazes Ltd.	lxxx
Vokes Genspring Ltd.	xxiv
Wallsend Slipway & Eng. Co. Ltd.	xiii
Walworth Ltd.	vi
Ward, Thos. W., Ltd.	lxxv
Weir, G. & J., Ltd.	lxiii
Whiffen & Sons Ltd.	lx
Wicksteed, C., & Co. Ltd.	xliv
Willcox, W. H., & Co. Ltd.	xxxi
Winn, Martin, W., Ltd.	lxxxi
Worthington-Simpson Ltd.	xxv
Yarrow & Co. Ltd.	lv
Zwicky Ltd.	lxxxiii

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Stations	Thermal efficiency (per cent).
Castle Donington, near Derby	31.92
Drakelow, Burton-on-Trent	31.02
Littlebrook "B," Dartford, Kent	30.20
Stourport "B" H.P., Worcs	30.08
Wakefield "B," Yorks	30.07
Portishead "B," near Bristol	29.97
Stella South, near Newcastle upon Tyne	29.90
Meaford "B," Stone, Staffs	29.83
Stourport "B" L.P., Worcs	29.70
Stella North, near Newcastle upon Tyne	29.32
Hams Hall "C," near Birmingham	29.17
Ince, near Ellesmere Port	29.13
Barking "C"	29.10
Battersea "B"	29.08
Dunston "B" II, Newcastle upon Tyne	29.01
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Carrington, near Manchester	28.75
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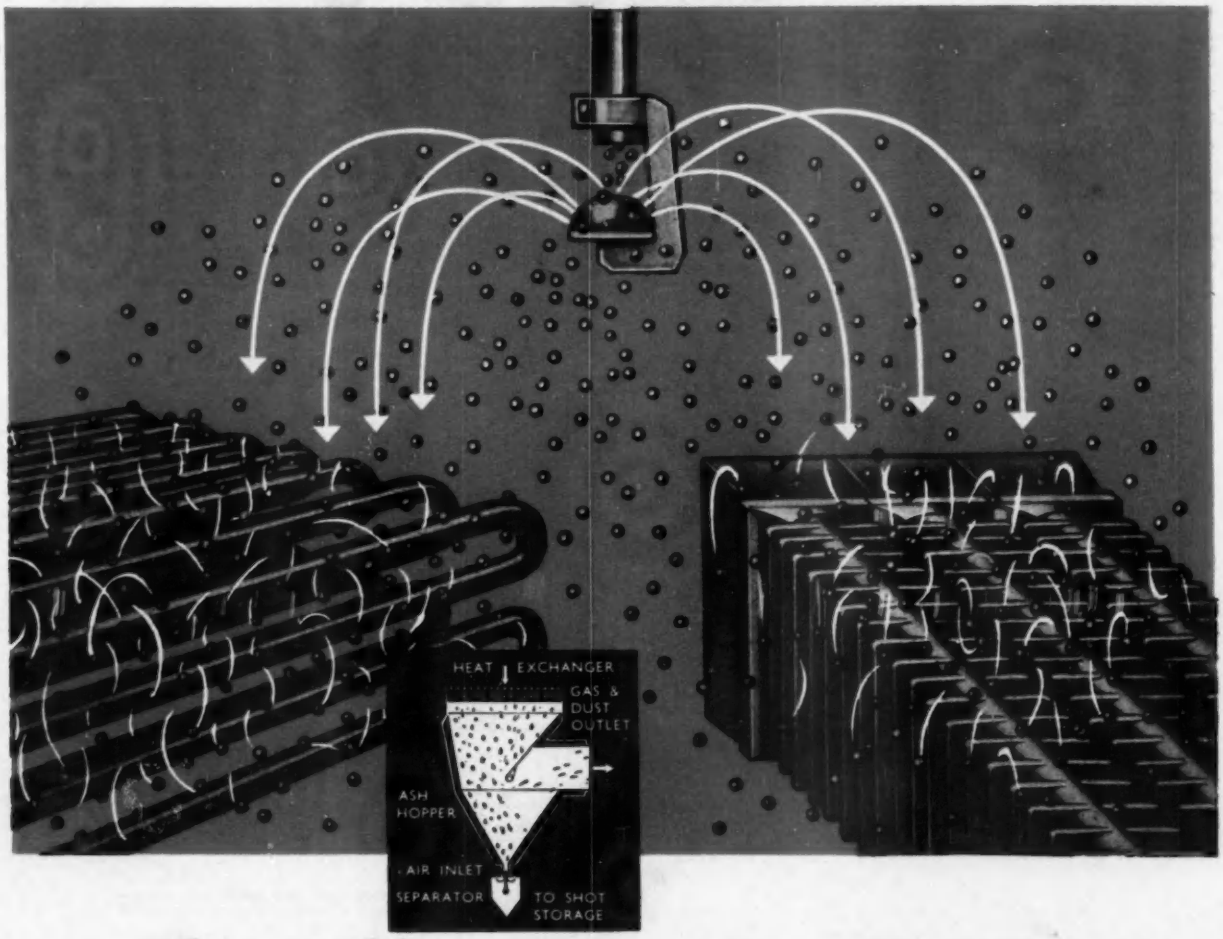

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